ADIO-ELECTRONIC ENGINEERING EDITION

Illinois U Library

RADIO & TELEVISION NEWS

JULY
1953

THIS ISSUE

DIRECT-COUPLED
TRUMENT AMPLIFIER

A MULTIRANGE
ENSITIVE CONTROL

DURATION MODULATION

PHASE ANGLE
SUREMENTS AT A.F.

SURING ATTENTUATION
H THE SLOTTED LINE

THE DAGE
USTRIAL TV CAMERA

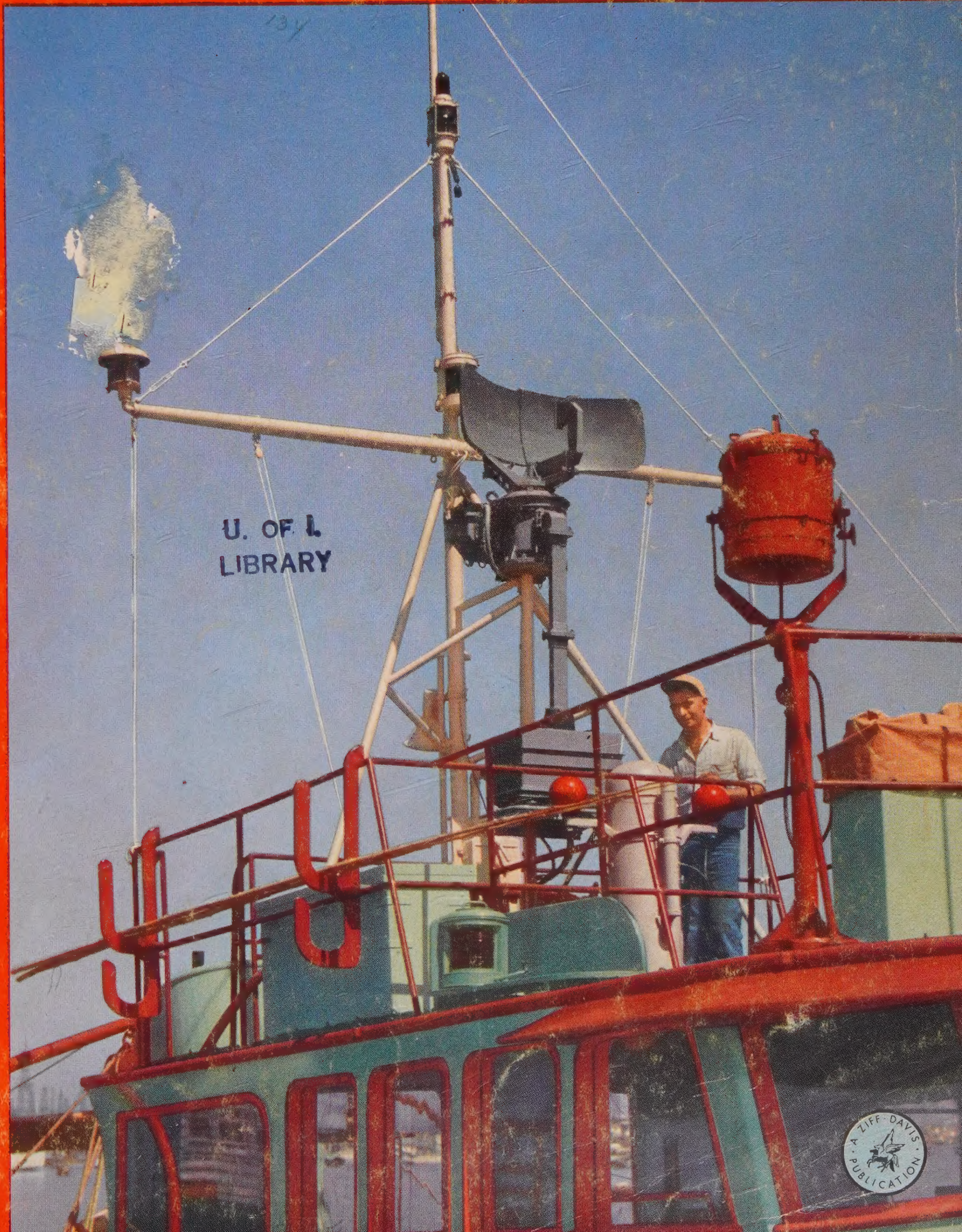
OW YOUR 1953 RCA
TV RECEIVER

INIMUM" MOBILE FOR
10-METER CD

SPEAKER ENCLOSURE

RADIAR PROTECTS
FISHING FLEETS

(See Page 35)



U. OF I.
LIBRARY

A ZIFF-DAVIS PUBLICATION

Partners

. . . for extra profit

EVERY successful service call automatically results in *extra* profit . . . in *dollars and cents* . . . and in increased "*customer confidence.*" You can insure *both* kinds of profit by coupling your good name in partnership with another . . . *RCA.*

Wherever you go, the familiar RCA emblem serves as your silent partner, helping you to sell your service and build repeat business. And the superior quality of RCA Receiving Tubes and Kinescopes protects your profit by cutting those costly call-backs caused by premature tube failures.

Helping you to safeguard your reputation is a vital, everyday service of RCA Tubes. And that protection is yours at no extra cost.

"Sign up" for Success

Identify yourself with RCA! Ask your *RCA Tube Distributor* today how *you* can qualify for a Dealer Identification Plaque displaying your name. He'll give you full details on the big RCA Sales Promotion Program.

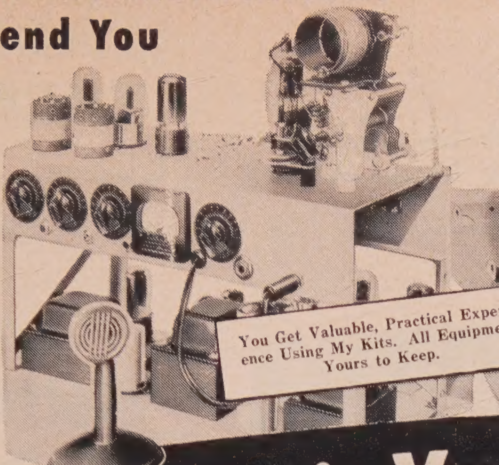
RCA ®

RADIO CORPORATION of AMERICA
ELECTRON TUBES HARRISON, N. J.

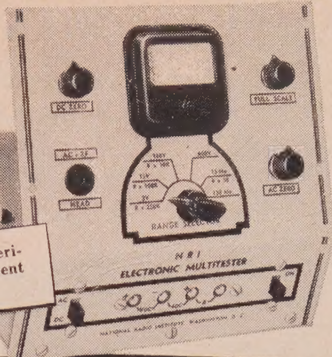
YOU PRACTICE COMMUNICATIONS with Kits I Send You

Build This Transmitter

As part of my Communications Course I send you parts to build the low power Broadcasting Transmitter shown at the right. Use it to get practical experience putting a station "on the air," perform procedures required of Broadcast Station operators. You build many other pieces of equipment with kits I send. I train you for your FCC Commercial Operator's License.



YOU PRACTICE SERVICING with Kits I Send You



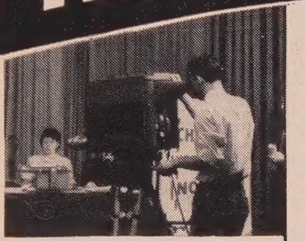
You Get Valuable, Practical Experience Using My Kits. All Equipment Yours to Keep.

Build This Tester

You build this Multitester from parts I send, use it to earn extra money in your spare time fixing neighbors' Radios. I also send you speaker, tubes, chassis, transformer, loop antenna, everything you need to build a modern Radio and other equipment. You get practical experience working with circuits common to both Radio and Television. All equipment is yours to keep. See and read about it in my FREE 64-page book. Just cut out and mail coupon below!

J. E. Smith has trained more men for Radio-TV than any other man.

I Will Train You at Home to be a RADIO-TELEVISION Technician



TELEVISION

Today's Good Job Maker

TV now reaches from coast-to-coast. Over 15 million TV sets are now in use; 108 TV stations are operating and 1800 new TV stations have been authorized. This means more jobs, good pay jobs with bright futures. Now is the time to get ready for success in TV. Find out what Radio-Television offers you. Mail coupon now for my 2 Books FREE!

I TRAINED THESE MEN

Has Growing Business

"I am becoming an expert Teletrician as well as Radiotrician. Without your practical course I feel this would have been impossible. My business continues to grow."—Philip G. Brogan, Louisville, Ky.

Good Job with Station

"I am Broadcast Engineer at WLPM. Another technician and I have opened a Radio-TV service shop in our spare time. Big TV sales here. As a result we have more work than we can handle."—J. H. Bangley, Jr., Suffolk, Va.

Praises NRI as Best Course

"I was a high school student when I enrolled. My friends began to bring their Radios to me. I realized a profit of $300 by the time I completed the course."—John Hopper, Nitro, West Va.

AVAILABLE to all qualified VETERANS UNDER G.I. BILLS

NRI Training Leads to Good Jobs Like These

Broadcasting: Chief Technician, Chief Operator, Power Monitor, Recording Operator, Remote Control Operator. **Servicing:** Home and Auto Radios, P.A. Systems, Television Receivers, Electronic Controls, FM Radios. **In Radio Plants:** Design Assistant, Transmitter Design Technician, Tester, Serviceman, Service Manager. **Ship and Harbor Radio:** Chief Operator, Assistant Operator, Radiotelephone Operator. **Government Radio:** Operator in Army, Navy, Marine Corps, Coast Guard; Forestry Service Dispatcher, Airways Radio Operator. **Aviation Radio:** Transmitter Technician, Receiver Technician, Airport Transmitter Operator. **Television:** Pick-up Operator, Voice Transmitter Operator, Television Technician, Remote Control Operator, Service and Maintenance Technician.

Tested Way to Better Pay

America's Fast Growing Industry Offers You Good Pay, Success

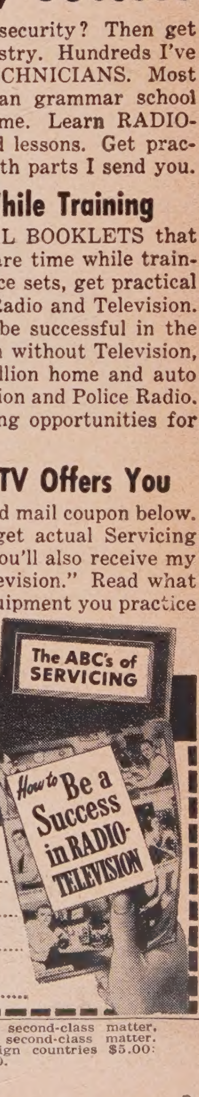
Do you want a good pay job, a bright future, security? Then get into the fast growing RADIO-TELEVISION industry. Hundreds I've trained are successful RADIO-TELEVISION TECHNICIANS. Most had no previous experience, many no more than grammar school education. Keep your job while training at home. Learn RADIO-TELEVISION principles from easy-to-understand lessons. Get practical experience on actual equipment you build with parts I send you.

Make Extra Money in Spare Time While Training

The day you enroll I start sending you SPECIAL BOOKLETS that show you how to service neighbors' Radios in spare time while training. Use MULTITESTER you build to help service sets, get practical experience working on circuits common to both Radio and Television. Find out how you can realize your ambition to be successful in the prosperous RADIO-TELEVISION industry. Even without Television, the industry is bigger than ever before. 105 million home and auto Radios, over 2900 Radio Stations, expanding Aviation and Police Radio, Micro-Wave Relay, FM and Television are making opportunities for Servicing and Communications Technicians.

Mail Coupon — Find Out What Radio-TV Offers You

Send for my FREE DOUBLE OFFER. Cut out and mail coupon below. Send in envelope or paste on postal. You will get actual Servicing Lesson to prove it's practical to learn at home. You'll also receive my 64-page Book, "How to Be a Success in Radio-Television." Read what my graduates are doing, earning, see photos of equipment you practice with at home. J. E. Smith, President, Dept. 3GE
National Radio Institute, Washington 9, D. C.



Good for Both-FREE

MR. J. E. SMITH, President, Dept. 3GE
National Radio Institute, Washington 9, D. C.

Mail me Sample Lesson and 64-page Book, FREE. (No salesmen will call. Please write plainly.)

Name .... Age ....

Address ....

City .... Zone ...... State ......

VETS write in date of discharge ....

RADIO & TELEVISION NEWS is published monthly by the Ziff-Davis Publishing Company at 64 E. Lake St., Chicago 1, Ill. Entered as second-class matter, July 21, 1948, at the Post Office, Chicago, Ill., under the act of March 3, 1879. Authorized by Post Office Department, Ottawa, Canada, as second-class matter. **SUBSCRIPTION RATES:** Radio & Television News—one year, U. S. and Possessions, Pan-American countries, and Canada $4.00; all other foreign countries $5.00: Radio-Electronic Engineering Edition—one year, U. S. and Possessions, Pan-American countries, and Canada $6.00; all other foreign countries $7.00.
Postmaster—Please return undelivered copies under form 3589 to 64 E. Lake St., Chicago 1, Ill.

48556

Editor and Asst. Publisher
OLIVER READ, *D.Sc., W1ETI*

Managing Editor
WM. A. STOCKLIN, *B.S.*

Technical Editor
H. S. RENNE, *M.S.*

Service Editor
CHARLES TEPFER

Amateur Radio Editor
N. ROSA, *W1NOA*

Assistant Editors
P. B. HOEFER
M. C. MAGNA

Television Consultant
WALTER H. BUCHSBAUM

Short-Wave Editor
KENNETH R. BOORD

Staff Artist
FRANK SAYLES

Draftsmen
A. A. GANS, *W2TSP*
J. A. GOLANEK

Advertising Manager
L. L. OSTEN
Midwest Adv. Manager
JOHN A. RONAN, JR.
Western Adv. Manager
JOHN E. PAYNE

COVER PHOTO: The radar installation on the fishing boat "White Star", a Pacific Coast vessel operated by the Van Camp Canneries of California. (Ektachrome by P. J. Samerjan)

ZIFF-DAVIS PUBLISHING COMPANY

Chairman of the Board and Publisher
WILLIAM B. ZIFF

President
B. G. DAVIS

Secretary-Treasurer
G. E. CARNEY

Vice-Presidents
H. J. MORGANROTH
Production Director
LYNN PHILLIPS, JR.
Advertising Director
H. G. STRONG
Circulation Director

BRANCH OFFICES
CHICAGO (1)
64 E. Lake St., AN 3-5200
LOS ANGELES (14)
Statler Center, 900 Wilshire Blvd., Mich. 9856

First in
radio-television-electronics
Average Paid Circulation over 200,000

RADIO & TELEVISION NEWS

Reg. U.S. Pat. Off.

Radio News Trademark Reg. U. S. Pat. Office • Television News Trademark Reg. U. S. Pat. Office.

CONTENTS

JULY, 1953

The Dage Industrial TV Camera .... *Harold E. Ennes* 31
Radar Protects Fishing Fleets .... *Ray Frank, W9JU* 35
Coaxial Speaker Dividing Networks .... *Lloyd C. Goss* 36
TV Interference Signals .... *Robert B. Gary* 38
125-Watt Audio System with Clipping .... *Robert F. Lewis, W8MQU* 39
Ferri-Loopstick Crystal Receiver .... *Joseph D. Amorose* 42
EW Speaker Enclosure .... *Jac Holzman* 43
Transistor Physics Simplified (Part 1) .... *S. P. Gentile & P. J. Barotta* 44
The Monimeter .... *Lloyd V. Broderson, W6CLV* 47
Know Your 1953 RCA TV Receiver 48
A "Minimum" Mobile for 10-Meter CD .... *Richard G. Finkbeiner, W8AQK* 52
Faster TV Servicing Through Circuit Tracing .... *Milton S. Kiver* 54
The Oscilloscope as an A.C.-D.C. Voltmeter .... *Walter H. Buchsbaum* 57
A Low Distortion Audio Signal Generator .... *George Ellis Jones, Jr.* 58
What's the Q-L-C .... *Warren Philbrook* 61
Mac's Radio Service Shop .... *John T. Frye* 62
TV Parts Replacement Guide 63
A Transistor "Electric Organ" .... *Louis E. Garner, Jr.* 64
New TV Grants Since Freeze Lift 75
New TV Stations on the Air 75
Service Hints on RCA TV Sets 118
Transistor Receiver .... *M. E. Quisenberry* 122
Radio-TV Service Industry News 130

DEPARTMENTS

For the Record .... *The Editor* 8
Within the Industry 16
Spot Radio News 24
Short-Wave .... *K. R. Boord* 66
What's New in Radio 80
Manufacturers' Literature 94
Technical Books 103

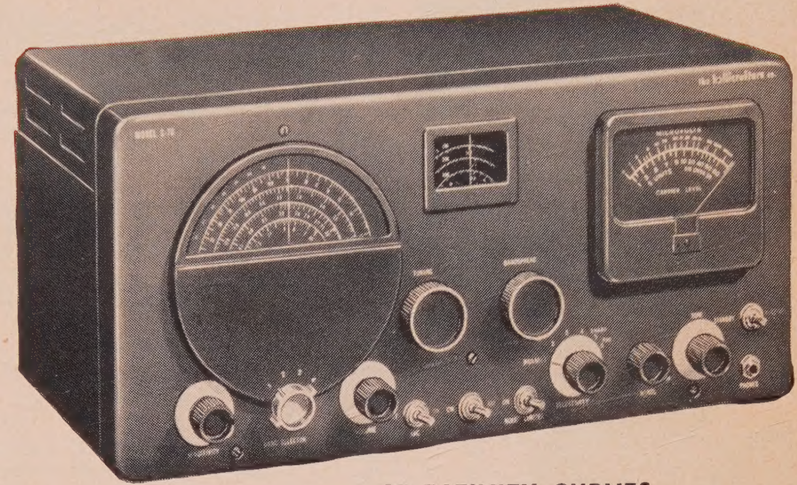
COPYRIGHT 1953
(All Rights Reserved)
ZIFF-DAVIS PUBLISHING COMPANY
Editorial and Executive Offices
366 Madison Ave., New York 17, N. Y.
VOLUME 50 • NUMBER 1

Member
Audit Bureau of
Circulations

SUBSCRIPTION SERVICE: All communications concerning subscriptions should be addressed to Circulation Dept., 64 E. Lake St., Chicago 1, Ill. Subscribers should allow at least four weeks for change of address.

CONTRIBUTIONS: Contributors are advised to retain a copy of their manuscripts and illustrations. Contributions should be mailed to the New York Editorial Office and must be accompanied by return postage. Contributions will be handled with reasonable care, but this magazine assumes no responsibility for their safety. Any copy accepted is subject to whatever adaptations and revisions are necessary to meet the requirements of this publication. Payment covers all author's, contributor's, and contestant's rights, title, and interest in and to the material accepted and will be made at our current rates upon acceptance. All photos and drawings will be considered as part of the material purchased.

Unmatched Selectivity—
Even at Twice the Money!



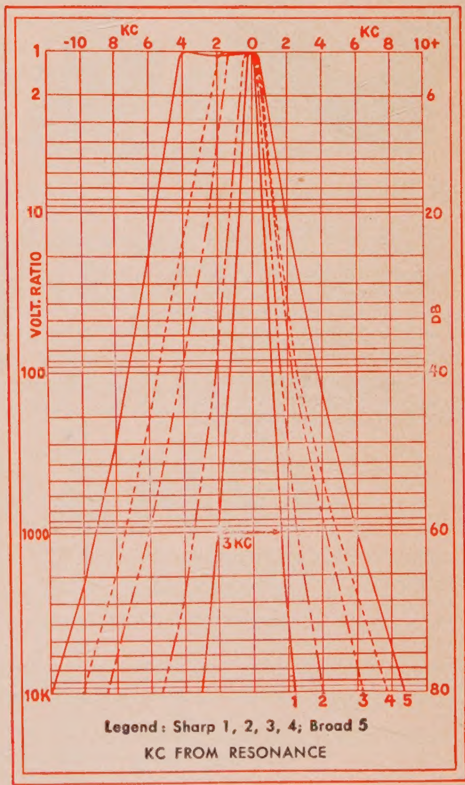
Hallicrafters Model S-76

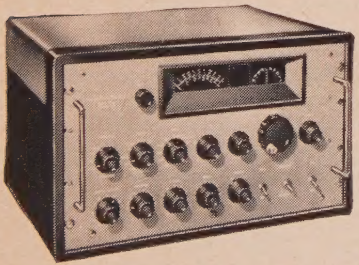
- ★ **Dual Conversion — no images!**
- ★ **Automatic Noise Limiter!**
- ★ **Giant "S" Meter — 4" Scale!**
- ★ **Temperature Compensation!**

The medium priced receiver that made the industry adjust its sights! Unmatched selectivity, even from receivers that cost twice as much. Just check the selectivity curves against other sets — see what Hallicrafters unmatched design experience can mean to you.

Model S-76 is a 4-band, dual conversion superheterodyne circuit, covering 538 kc to 32.0 mc. Bands: 538 to 1580 kc, 1720 kc to 4.9 mc, 4.6 mc to 13.0 mc, 12 mc to 32.0 mc. Two 3 gang tuning condensers are used, the first for main tuning and the second gang for fine tuning and electrical band spread. 1 r-f, 2 conversion, 2 i-f stages. 5 position selectivity. Phono input jack. 3 watts audio output. Only $\$179^{50}$

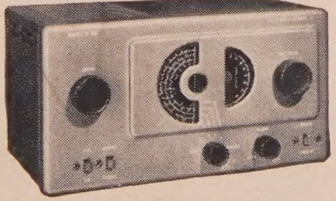
SELECTIVITY CURVES
S-76





TVI Suppressed 100 Watter—Model HT-20—Continuous coverage from 1.7 mc to 31 mc. Full band switching. Choice of 10 crystals. Shielded, filtered r-f compartment plus built-in, low-pass 52 (ohm) coaxial line output filter reduces to more than 90 d.b. all responses over 40 mc. Only **$449.50**

The Finest Buy in SW!—The S-38C—Best performance per dollar, you'll find, the S-38C is the outstanding low priced set on the market. 540 kc to 32 mc in 4 bands. Maximum sensitivity per tube — far out-performs ordinary broadcast sets. Built-in speaker. 115 V AC or DC. 4 tubes plus rectifier. **$49.50**



hallicrafters

Chicago 24, Illinois
Hallicrafters, Ltd., 51 Camden St., Toronto, Canada

World's Leading Exclusive Manufacturer of Communications Equipment, High Fidelity, Radio and Television

E-V ADDS THE MAGIC TOUCH TO TV RECEPTION

NEW all channel UHF TV CONVERTER

MODEL 3300

Truly the ultimate in a UHF TV Converter. Engineered and built by **Electro-Voice**, the E-V 3300 combines the finest in design, construction and performance. It is thoroughly field proved.

Adds all UHF Channels to VHF Sets

Non-slip micrometer type tuning system* provides smooth, accurate, continuous tuning of all UHF channels 14-83. No band switches, strips or coils. New high-efficiency low-loss circuit. Operates with either separate UHF and VHF antennas or on all-channel (2-83) antenna. Adequate shielding. One control turns Converter and TV set "on" or "off" and switches to correct antenna. Utilizes channels 5 or 6 of VHF TV set as Intermediate Frequency. Does not affect VHF reception.

Installation is simple—connect to antenna input of VHF TV set and just plug in. For 105-125 volts, 50-60 cycles AC. Housed in small, attractive dark brown cabinet, 7¾" x 5¼" x 6¼". Completely self-contained, ready for installation.

MODEL 3300. List Price, **$39.50**

*Patent Applied For

Send for Bulletin No. 188

Electro-Voice

ELECTRO-VOICE, INC.
410 CARROLL STREET • BUCHANAN, MICH.
Export: 13 E. 40th St., New York 16, U.S.A. Cables: Arlab

For the RECORD

BY THE EDITOR

SUMMERTIME REVENUE

THE hot weather that lies ahead of us and the extra daylight hours will keep many TV viewers out-of-doors and away from their sets to enjoy the nice weather. The aggressive service technician will take advantage of the summer months to survey his customers for antenna replacements.

It is a fact—not fancy, that a great proportion of TV antenna installations in fringe areas, especially those made two to four years ago are outmoded and inferior compared with late designs.

We observed, during a recent trip, that many antenna systems in fringe areas and in damp climates are still using flat twin-lead.

Many of these leads are lying flat on the roofing with an accumulated film of soot (carbon) and the leads draped over the metal gutter, en route to the receiver. It is commonplace to find pipe masts improperly guyed with uneven stress at the point of connection. Many guy wires are staggered on the pipe and easy prey to a high wind.

Stand-off insulators are rusted and are discoloring the dwelling and many installations are still without the essential lightning arrester.

It is amazing that these conditions do exist. It is even more amazing that dealers and technicians are so completely blind to the opportunities that are theirs in tapping the replacement market for newer and more efficient antennas and accessories.

Every home owner is familiar with the effects of corrosion on his lawn mower, power tools, the kids' bicycles, and on his plumbing. It is not difficult to explain the necessity for replacing his outside antenna and hardware with new and more efficient arrays.

We have talked with many technicians and have found many to be timid and hesitant about approaching a customer on the subject of antenna replacement. An auto service manager never hesitates to recommend a new spark plug or new tires to a customer if he feels he can justify a sale.

In many instances, he will be doing a customer a real favor and will help to prevent accidents caused by the toppling of poorly guyed masts and towers. He will replace all stand-offs with new parts which he will protect with one of the several sprays now on the market. He will replace all the old flat twin lead with the more efficient tubular types and he will install an approved lightning arrester, properly grounded and correctly located.

The summertime is ideal for an intensive campaign to check on all the antenna installations that have been in service over two years—especially near salt water. If the installation is one of your own, your approach should be one which implies that you wish to make your customary "periodic" inspection because of the damage such installations can incur due to weather. You should have no difficulty in obtaining permission to make such an inspection. Your report to the homeowner should be complete and carefully worked out. His confidence in your judgement and television "know-how" will probably mean a green light for any work that you may recommend. In some instances only guys, certain hardware accessories, or arresters will need replacing—in other cases the entire installation will have to be renewed.

On "cold" calls on customers for whom you have not done work previously take time to sell yourself and your service before requesting permission to make an inspection of their antenna systems. Most home owners are "damage" conscious and will accept suggestions that will make their property less hazardous if they are approached correctly.

There is no reason why you can't glean many leads from your older service record cards or those that have been in the inactive file for some time. The damage a falling antenna can cause is no small matter and may even endanger life—so the average householder will welcome your suggestion to "take a look before it is too late."

Don't forget to take a look at "John Doe's" antenna too while you are in his neighborhood. Even though he's a new customer and even though his antenna was erected recently and is in good condition, he will long remember your thoughtfulness for two minutes of your time spent in re-checking the recently installed array.

There is still plenty of room in the service field to employ more common sense to the erection of antennas.

Multi-element antennas are still being strapped to old chimneys that have weakened through the years. Many are incapable of supporting the additional weight and stress of an antenna and represent a real hazard to the dwelling and its occupants.

These hazards should be eliminated and there is no better time than now. . . . . O.R.

AMAZING NEW TRAINING PLAN

Leonard C. Lane,
B.S., M.A.
President of Radio-Television Training Association,
Exec. Dir. of Pierce School of Radio and Television

NOW . . . YOU CAN BECOME A
LICENSED* TV TECHNICIAN
LICENSED TV MEN MAKE MORE MONEY

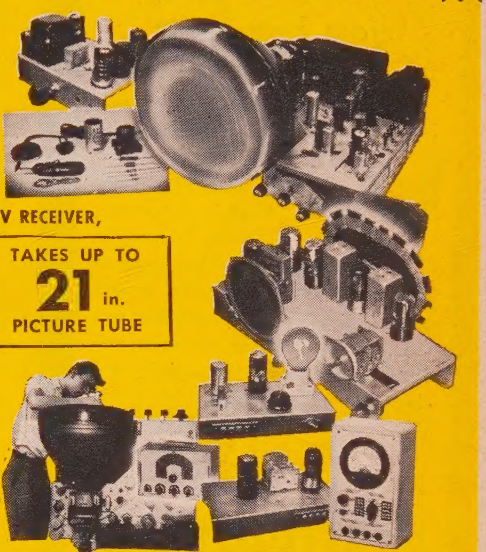
SET-UP YOUR OWN HOME LABORATORY WITH THE 15 BIG TELEVISION-RADIO KITS WE SEND YOU (At No Extra Cost)

AT NO EXTRA COST! YOU GET A ROUND TRIP TO NEW YORK CITY

FROM ANYWHERE IN THE U.S. OR CANADA—I pay your way to New York and return, PLUS 2 FREE weeks, 50 hours of advanced instruction and shop training at the **PIERCE SCHOOL OF RADIO & TELEVISION.** You use modern electronics equipment, including student-operated TV and Radio stations. You go behind the scenes of New York's big Radio-TV centers, to study first hand. And I give you all this AT NO EXTRA COST! (Applies to complete Radio-TV course only.)

Only RTTA makes this amazing offer.

YOU BUILD AND KEEP ALL THESE UNITS



—**INCLUDING BIG SCREEN TV RECEIVER,** plus Super-Het Radio Receiver, R.F. Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Receiver, AC-DC Power Supply. Everything Furnished Including All Tubes, and Big TV Tube

TAKES UP TO 21 in. PICTURE TUBE

EXTRA FEATURES THAT MEAN MORE MONEY FOR YOU!

Thousands of new job opportunities will be available for you right in your own state, now that the government has lifted restrictions on new TV stations. My simple, successful methods can PREPARE YOU NOW to take your place in America's booming TELEVISION and Electronics industries . . . help you get the success and happiness that you always wanted out of life. You learn the practical, easy way by using actual parts and equipment in the 15 big Radio-TV kits I send you, including a COMPLETE TV RECEIVER . . . yours to build and keep.

My Advanced Training Prepares You For Better Jobs

Then, after you finish your training for a position as a full-fledged TV Technician—where you can write your own ticket and choose from dozens of fascinating careers—*I don't stop there!* I continue to train you—AT NO EXTRA COST—to qualify for even *better* pay in the BETTER JOBS that demand FCC licenses, with my . . .

FREE* FCC COACHING COURSE

PREPARES YOU AT HOME FOR YOUR FCC LICENSE

THE BEST JOBS IN TV AND RADIO REQUIRE AN FCC LICENSE

Given to every student at NO EXTRA COST after TV Theory and Practice is completed.

NOW! Advanced FM-TV Training For Men Who Know Radio

Prepares You For Higher Pay Jobs In A Few Months

COMPLETE theory and practical training course . . . complete with kits including large screen TV receiver.

FCC License Coaching Course Included FREE.

ATTENTION! VETERANS!

MY SCHOOLS FULLY APPROVED TO TRAIN VETERANS UNDER NEW G.I. BILL! If discharged after June 27, 1950—CHECK COUPON BELOW! Also approved for RESIDENT TRAINING in New York City . . . qualifies you for full subsistence allowance up to $160 per month.

I GET MY GRADUATES GOOD PAYING JOBS

"As Merchant Ship Radio Officer, I receive $867. for 40-day trip. Your training helped me get this fine position."
— **Stanley Nawrocki**

"I now hold a fine airlines position at La-Guardia Field, New York City, thanks to your excellent training."
— **Joseph Rosenberg**

"Your excellent instruction helped me get my present job as an airport radio mechanic for American Airlines."
—**Eugene E. Basko**

"Thanks to your training, I qualified for a good job as a Receiver Tester at Federal Telephone and Radio."
—**Paul Frank Seier**

Many others working at NBC, RCA, CBS, Dumont, Philco, Emerson, Admiral and other leading firms.

RADIO-TELEVISION TRAINING ASSOCIATION

1629 Broadway, Radio City Station, New York City 19, N. Y.

Approved as a Correspondence School under the laws of the State of New York

***BOTH FREE** New Illustrated Book plus Sample Lesson*

NO SALESMAN WILL CALL!

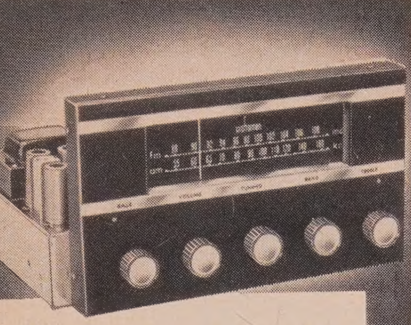
Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSN.
1629 Broadway, Radio City Station
New York 19, N. Y. Dept. T-7

Dear Mr. Lane:

Mail me your *NEW* FREE BOOK and SAMPLE LESSON that will show me how I can make BIG MONEY in TELEVISION. I understand I am under no obligation and no salesman will call.

Name Age
Address
City Zone State

I am interested in: ☐ Radio-TV ☐ Advanced FM-TV
VETERANS: If qualified under new G.I. bill, check here ☐ Resident Study ☐



We rest our case on evidence you can hear

Words can't prove the performance of this superb High Fidelity Tuner. Neither can witnesses. When it's time for a decision, your judgement of the CRAFTSMEN 10 is based on one thing: evidence you hear *with your own ears*. Listen—and the conclusive evidence of incomparable sensitivity and flexibility will turn your trial into a lifetime of *distinctly* better listening.

the craftsmen® 10
high fidelity
FM-AM tuner

- Two cathode followers furnish both audio output and detector output for remote installations.
- Built-in pre-amplifier, compensated for variable reluctance pick-ups.
- Automatic Frequency Control entirely eliminates drift, simplifies tuning.
- 5 microvolts sensitivity on both FM and AM.
- 10 kc filter on AM eliminates inter-station squeal.
- Bass and treble tone controls for boost, cut, or 20-20,000 cycle flat response.

JUDGE THE C-500 TOO! Williamson all-triode circuit—99.99% distortion-free!

high fidelity by craftsmen
means distinctly better listening

For information, write to:
The radio CRAFTSMEN, Inc.
Dept. R-7, 4401 N. Ravenswood Ave.,
Chicago 40, Ill.

Within the INDUSTRY

LOUIS L. ACKERMAN has been appointed director of purchasing for *Warwick Manufacturing Corporation,* Chicago radio and television firm.

He was formerly assistant director of purchasing for *Capehart-Farnsworth Corporation* of Ft. Wayne, Indiana and director of purchasing for *Arvin Industries, Inc.*

In his new position Mr. Ackerman will have charge of purchasing for the company's Chicago plant and its recently-acquired plant in Zion, Illinois.

* * *

JERRY KIRSCHBAUM, vice-president of *Precision Apparatus Corp.,* has been named president of the Sales Managers Club, Eastern Group.

Serving with Mr. Kirschbaum are Bob Ferree, distributor sales manager of *International Resistance Corp.* as vice-president; and Walter Jablon, vice-president of *Bogen Sound Systems* as secretary-treasurer.

B. L. Cahn, vice-president of *Insuline Corporation of America,* was elected director to the executive board of the Show Corporation for a two year term while Vin Uhlrich, renewal tube sales manager for *National Union Radio Corp.,* continues his directorship for another year.

The Sales Managers Club is one of the sponsors of the annual Parts Show held in Chicago.

* * *

ROBERT B. BEETHAM is the new works manager of the Hicksville plant of *Amperex Electronic Corporation.*

For the past five years, Mr. Beetham was associated with the *Airborne Instrument Laboratory,* where he held the position of executive assistant to the vice-president in charge of research and engineering.

Prior to this period, he was affiliated with the *Collins Radio Company* for a period of fourteen years in an engineering capacity and later as assistant to the president.

* * *

OXFORD ELECTRIC CORPORATION of Chicago has acquired two new firms, **RADIONIC CONTROLS, INC.** and **WILDER MFG. CO.** both located near Carbondale, Ill. They will be operated as subsidiaries of the parent firm . . . **GENERAL ELECROSONICS, INC.** of New Yor
City and New Rochelle has merge
with **SEGAL LOCK AND HARDWARE CO**
INC. of New York . . . **COMMERCIA**
PRODUCTS has been recently estab
lished in Toledo, Ohio to manufactur
antenna mounting equipment an
parts. Principals of the new firm in
clude Glenn W. Braun and associate
. . . **AEROVOX CORPORATION** of Ne
Bedford, Mass. has acquired the **CINE**
MA ENGINEERING CO. of Burbank
California and will operate the ne
subsidiary as a division of the cor
poration . . . **BARTH MANUFACTURIN**
CO. of Milldale, Conn. has been sol
and reorganized under the name o
BARTH ENGINEERING AND MANUFAC
TURING CO. The new concern i
headed by Charles Russell of Wes
Hartford. Supplementing present man
ufacturing operations, the new concer
plans to emphasize engineering devel
opment and production of electroni
electromechanical, and electrohydrau
lic control equipment . . . **HYTRO**
RADIO & ELECRONICS CO. has officiall
changed its name to **CBS-HYTRON.** Th
firm is the radio and television tub
manufacturing division of **CBS,** as we
as producers of the corporation's lin
of germanium diodes and transistor

* * *

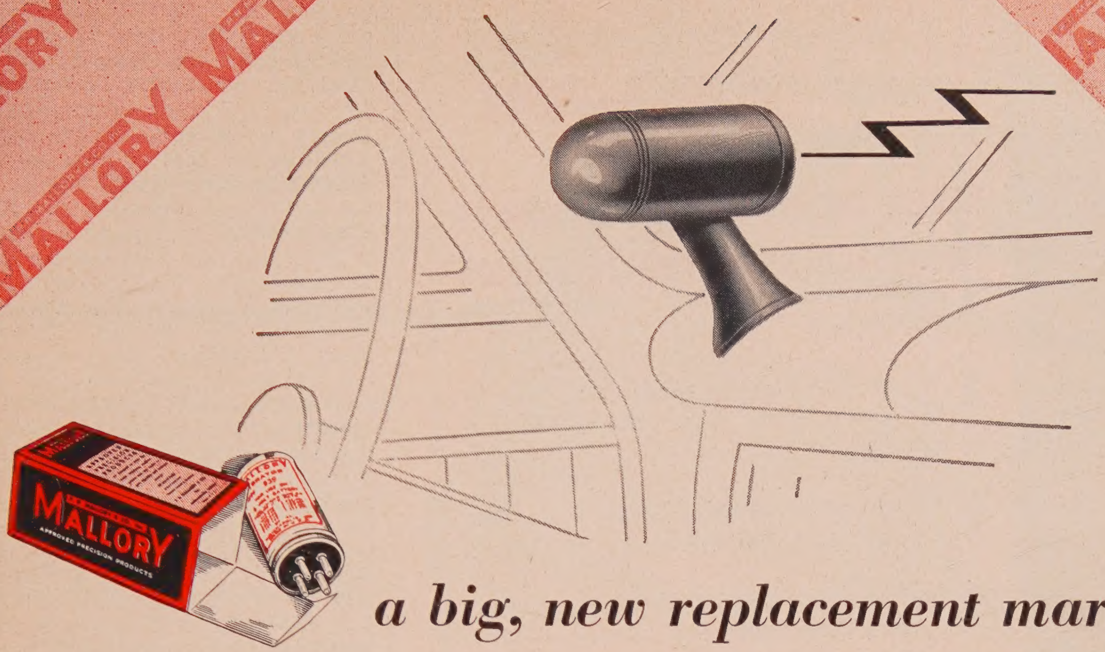
H. WARD ZIMMER has been electe
president of *Sylvania Electric Pro*
ucts Inc. while Don G. Mitchell, former president, has been elevated to the post of chairman of the board.

Mr. Mitchell, who has been president of the firm since 1946, succeeds as
chairman, Max. F. Balcom, a membe
of the *Sylvania* organization and pre
ecessor companies for 35 years. A
though Mr. Balcom is retiring fro
the chairmanship, he will continue t
serve the company as a director an
in a consultative and advisory ca
pacity.

The new president has been exec
tive vice-president since 1950 and f
three years prior to that time w
vice-president in charge of operation

* * *

QUAM-NICHOLS COMPANY is currentl
moving into its new block-long facto
and executive offices at the interse
tion of Marquette Road and Prair
Avenue on Chicago's South Side. Th
new plant will give the speaker man
facturer an estimated 75,000 square fe
of production space . . . **WESTCHESTE**
ELECTRONIC SUPPLY CO., INC. ha
leased an entire building at 600-61



a big, new replacement market for Mallory Vibrators...ELECTRONIC HEADLIGHT DIMMERS

THE MARKET Already, over a hundred thousand new automobiles are equipped with automatic, electronic headlight dimmers. By the end of the year this figure will be multiplied several times . . . and the first of them are beginning to need service.

THE OPPORTUNITY This can be big business for you . . . business that may grow even larger than automobile radio service. But, if you are to get full benefit of this new market, automotive shops must be told that these are *electronic devices . . . devices that should be serviced by qualified radio service men.* Explain it, now, to every car dealer and shop for which you do service work.

THE PRECISION PARTS Automatic headlight dimmers depend on a vibrator power supply unit. When it is time for vibrator replacement, you can be sure the job is right if you use Mallory. As in the case of automobile radios, Mallory worked closely with the manufacturer and played an important part in this new development by supplying the first original equipment vibrators. With just three Mallory Vibrators you can service any unit now on the market.

P.R. MALLORY & CO. Inc.
MALLORY
CAPACITORS • CONTROLS • VIBRATORS • SWITCHES • RESISTORS
RECTIFIERS • POWER SUPPLIES • FILTERS • MERCURY BATTERIES
APPROVED PRECISION PRODUCTS
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Depend on Mallory
for
Approved Precision Quality

When reputations rely upon quality... PERMA-TUBE stands the test!

HERE'S THE PERMA-TUBE RECORD AT *MONESSEN RADIO AND TELEVISION

1. 1800 installations without a single antenna mast failure.
2. Not a single claim for rusted, bent, twisted, or broken masts since PERMA-TUBE was adopted in 1949.
3. PERMA-TUBE installations show no wear after 41 months (average antenna life 27 months).
4. Storm that flattened 100 antennas failed to buckle PERMA-TUBE masts.
5. PERMA-TUBE supports shop's fine reputation for high-quality work.

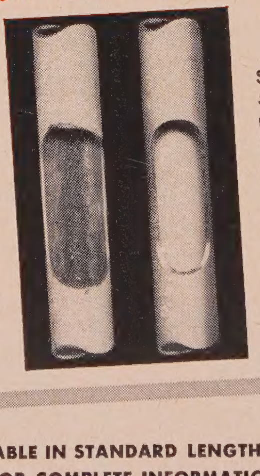
Here's why PERMA-TUBE backs up quality service

1. PERMA-TUBE IS STURDY . . . it's made of special, high-strength, J&L steel.
2. PERMA-TUBE IS CORROSION-PROOF . . . it's treated with vinsynite—then coated *inside and outside* with a metallic vinyl resin base.
3. PERMA-TUBE IS EASILY INSTALLED . . . it's the only mast with *both ends of the joint machine fitted.*

* Facts listed are published through the courtesy of Mr. Anthony Todaro, part owner of a thriving radio and TV shop in Monessen, Pa.... Monessen Radio and Television. Mr. Todaro's growing business is based upon a policy of "the best" in material and service.

Here's proof of how Perma-tube resists corrosion

Section of ordinary conduit tubing used for TV masts after 96 hours in a salt spray test (A.S.T.M. Designation B-117-49T) to accelerate corrosion. Extensive rust inside the mast has reduced strength—caused rusty water to drain onto the owner's home.



Section of PERMA-TUBE after 500 hours salt spray test shows no evidence of corrosion. Strength has been retained and the chance of rust streaks on owner's home is eliminated. Note sturdier wall thickness of PERMA-TUBE sample.

PERMA-TUBE IS AVAILABLE IN STANDARD LENGTHS . . . DIAMETERS . . . WALL THICKNESSES. FOR COMPLETE INFORMATION *MAIL THIS COUPON*

J&L STEEL

Jones & Laughlin Steel Corporation
495 Gateway Center, Pittsburgh 30, Pa.

Without charge, please send me:
☐ Name of nearest distributor
☐ Complete information on PERMA-TUBE

Name________________

Company________________

Address________________

Mamaroneck Ave. in White Plai
N. Y. The two-story brick structu
provides over 12,000 square feet
space for conducting the company
distributor business . . . **FEDER**
ELECTRIC PRODUCTS COMPANY
Newark, N. J. is now completing a ne
factory in Los Angeles. The plant h
45,000 square feet of floor space a
80,000 additional square feet for par
ing and future expansion . . . **ARRO**
ELECTRONICS has opened a new sto
at 215 Front Street in Hempstead, L.
The new outlet, the company's fourt
will stock a complete line of parts a
equipment for service technicia
hams, high-fidelity fans, experime
ers, hobbyists, engineers, and indu
trial purchasers . . . **JERSEY SPECIAL**
COMPANY has recently completed
new plant on Burgess Place, Mounta
View, N. J. . . . **SENTINEL RADIO COR**
has opened a factory-owned branch
handle distribution of the company
radio and TV sets in the Greater C
cago area. The branch is located
1234 W. Washington Blvd. in Chica
. . . Production is underway at the ne
INTERNATIONAL RESISTANCE CO
PANY plant in Asheville, N. C. T
newly-built, $200,000 plant will e
ploy approximately 500 persons wh
operating at full strength . . . **S**
RADIO AND ELECTRONICS CO., IN
opened its new "electronic superma
ket" at 650 Avenue of the Americas
New York with an elaborate op
house attended by civic and indust
leaders. The headquarters provid
20,000 square feet of sales space
on one floor.

* * *

STEVE VAN ROEKEL has been appoint
general sales manager of the *Stephe*
Manufacturing Corporation of Culver City, California.

He comes to his new post from Omaha, Nebraska where he owned and operated the *Midwest Sound Company,* sound equipment distributors. The new executive is
expert in electronics, having had
years of experience in the field.

Mr. Van Roekel studied electri
engineering at the University of C
rado and served for three years w
the Army Signal Corps during Wo
War II as a specialist in airbo
radar.

* * *

RAYMOND C. COSGROVE, formerly
ecutive vice-president of *Avco Ma*
facturing Corp., has been named m
agement consultant of *National C*
pany, Malden, Mass. . . . **D. W. GU**
has been appointed to the newly-
ated post of assistant-general s
manager of radio tube and TV pict
tubes sales for *Sylvania Electric P*
ucts Inc. . . . NARDA has appoi
CARL F. GUINEY to the post of in
ance director for the trade associat
He will be in charge of the organ

(*Continued on page* 76)

DIRECT-COUPLED INSTRUMENT AMPLIFIER

By

GEOFFREY H. GREY

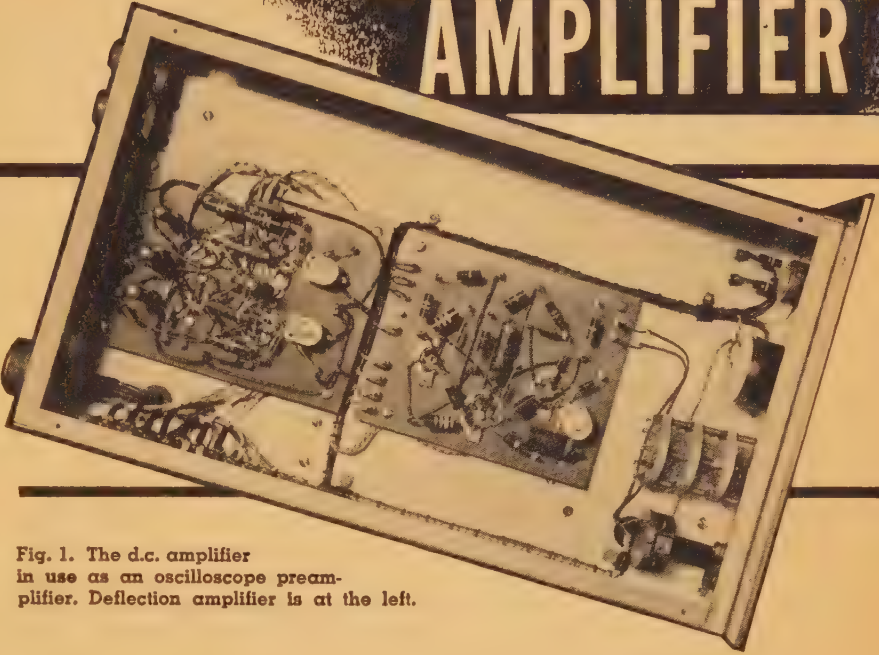


Fig. 1. The d.c. amplifier in use as an oscilloscope preamplifier. Deflection amplifier is at the left.

A stable amplifier with a gain of 200 and a frequency response that is essentially flat from d.c. to 500 kc.

A DIRECT-COUPLED amplifier with a voltage gain of 200 and a frequency response to 500 kc. has a number of possible uses. It may serve as the voltage amplifier (as distinct from the output or deflection amplifier) in oscilloscopes, in both a.c. and d.c. vacuum-tube voltmeters, and as an ordinary audio amplifier. More specialized applications of this type of circuit are to be found in analog computers and in the field of dynamic measurements on mechanical structures.

A successful device of this type, intended primarily for the oscilloscope application, is pictured in Figs. 3 and 4. This amplifier is believed to be typical of many commercial circuits in current use, and there is nothing bizarre about it. As to its use in oscilloscopes, the desirability—in a general purpose laboratory instrument—of having response to d.c. is hardly controversial. Any good commercial oscilloscope now has this feature whenever the proposed uses in any way justify its inclusion.

Less common is the use of identical horizontal and vertical amplifiers. It is highly desirable to have the *X* and *Y* axis performances as alike as possible, for if the *X* and *Y* amplifiers are carefully aligned and are stabilized by substantial amounts of inverse feedback, it is possible to place some faith in methods of measurement involving Lissajous and similar figures. It is then possible to make accurate measurements of relative phase shifts at comparatively high frequencies, bordering on the high frequency limits of the oscilloscope amplifiers themselves. This is important when one is attempting to design and construct stable feedback amplifiers.

In a general-purpose oscilloscope of the author's design, the plans called for a sensitivity in both *X* and *Y* axis channels of about 28 millivolts per inch for d.c. signals, and the equivalent 10 millivolts r.m.s. per inch for a.c., to be obtained by feedback amplifiers as alike as possible. The first amplifier in each channel was to supply most of the required voltage gain of 200, while the second—or deflection amplifier—was to have a fairly low voltage gain (15) and the necessary high output voltage capability for driving the plates of the cathode-ray tube. The preamplifier section of both vertical and horizontal amplifiers is the subject of this article.

In arriving at the proper configuration for the preamplifier, the following factors were considered:

1. Drift, due to random changes in emission and to line voltage fluctuations
2. The simplicity and flexibility of the type of feedback divider whereby the adding of the input and feedback voltages occurs at the input grid rather than at a cathode
3. The provision of about 40 db of feedback in the midband, and the maintenance of as much of the original feedback to as high a frequency as possible consistent with good transient response and absolute stability against oscillations
4. Minimization of the number of stages and components
5. Availability of a "spare" grid at the input stage, so that there would be a place to insert a correcting voltage if a servo-type stabilizer to correct for d.c. errors were to be added later (This is an expensive and troublesome modification, but it is capable of virtually removing drift as a problem.)
6. Operation on + and −300 volt regulated power supplies, without intermediate supplies (These ± 300 volt supplies appear to be standard in a great deal of instrument work, notably in large installations such as computers, and the author confines himself to their use wherever possible. In this particular amplifier, any intermediate voltages for the screens of pentodes, which in a d.c. amplifier have to be regulated, were to be obtained from local regulators of the simplest type. If one has a number of screens at the same potential, for example, it pays to put in a common supply to regulate all of them.)
7. Avoidance of d.c. heater supplies (Regulation of the heater of the input tube by some simple means such as a current-regulator tube was not ruled out, however.)
8. Input impedance to be 2 megohms shunted by a small capacitance, and output impedance to be of the order of a few hundred ohms

The drift requirement led immediately to the use of some form of cathode compensation, and the desire for a spare grid indicated that the cathode-coupled or differential amplifier would be the most suitable of the many circuits available. This type of amplifier stage is most useful in that one may

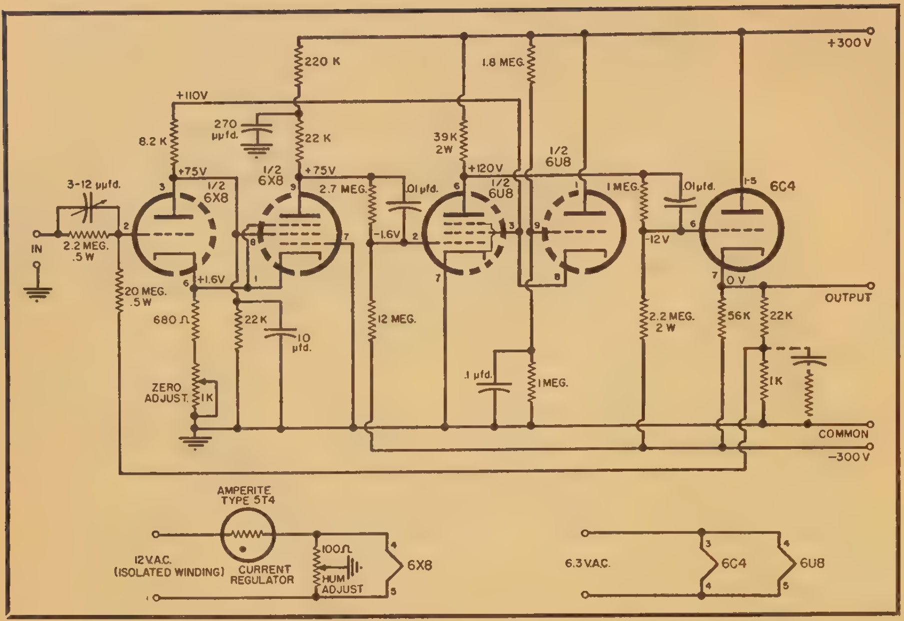


Fig. 2. Complete circuit diagram and parts values for the d.c. amplifier. The heater system for the amplifier is shown at the bottom of the diagram.

use either of the control grids (see Fig. 2) as the input grid, the other grid being grounded or used for inserting feedback voltages. There is a choice of either positive or negative voltage gain, so that negative feedback may be used around the whole amplifier regardless of whether the total number of stages is even or odd. Use of an extra stage of gain just to make the over-all gain come out with the desired sign is therefore unnecessary, and the remainder of the amplifier may be designed without such restrictions. In this case, the first stage was set for positive gain (+200) and the second and last stage had—as usual—a negative gain, so that the over-all gain was negative.

There was something of a conflict regarding the choice of a tube for the input stage. It was desirable to use pentodes in this particular design, for the gain was to be obtained with as few stages as possible, while at the same time it was important to use a dual tube, preferably with a cathode sleeve common to both sections in the manner of the 6J6. The new triode-pentode 6X8 has such a symmetrical structure, with a pentode on one side of the cathode and a triode on the other. Use of this tube offers both high gain and a chance for drift reduction. Since it is not built for low-level service, it cannot be expected to give good results so far as hum and microphonics are concerned, although with reasonably low space currents it would seem to be as good as most tubes in matters of grid content. Selection of tubes is always possible, of course, if one has a large stock at one's disposal, but in this case shock-mounting was resorted to and the grid current was minimized to a reasonable degree by choice of operating conditions. Hum was not troublesome.

Having chosen the tube and the configuration, it was necessary to allow the bandwidth, gain, grid current, and noise considerations to determine the circuit constants. Past experience in the design of d.c. amplifiers indicated that about a milliampere of plate current and grid biases of about —1.6 volts were most suitable for circuits of this general nature. When the 6X8 has about 75 volts on the triode plate and pentode screen, it will draw roughly 900 microamperes per side for a grid bias (the same on both sides) of the required value. With both triode plate and pentode screen at the same potential of +75 volts above the cathode, and with both sides drawing about equal cathode currents, it was hoped that drift would be minimized. (The triode plate and pentode screen influence their respective cathode currents to about the same degree, for equal grid biases, due to the well-known pentode property of disregarding plate potential once it is above a certain minimum.) About all that can be said at this time, since the more elaborate tests have not yet been performed, is that after a five-minute warmup the drift is very noticeably less than that which has previously been experienced with twin-triode input stages. The drift is not excessive for oscilloscope uses unless a really accurate d.c. measurement must be made.

The triode plate and pentode screen were run from a divider at about +75 volts. Using a similar potential for the pentode plate, the plate load turned out to be about 250*K*. This proved to be adequately high from the gain standpoint and low enough to get the bandwidth desired without having to us too much or too many stages later on

The voltage divider for the triod plate and pentode screen was made t draw 3.5 ma., the screen taking abou 0.2 ma. under quiescent conditions. Thi point was then bypassed with a 1-μfd capacitor, chiefly because past worl had shown that noise and hum migh be reduced if this were done. The divider is regenerative in action, an there is no loss in gain due to its regulation. In some cases, the gain wa observed to go up when this junctio was bypassed. (Any change in triod plate potential constitutes an equa change in pentode screen potential, an decreases in gain due to losses in th triode half are made up by increase gain in the pentode half.)

Remaining gain requirements wer met by use of another triode-pentode— a 6U8, the pentode section supplying a voltage gain of about 100 and the triod serving as a simple regulator of th cathode-follower variety for the screen of the pentode. Power supply economy held the pentode plate current to abou 4.5 ma., which was also felt to be th maximum for a reasonably long life The 39*K* load resistor allows a goo bandwidth, and the comparatively high plate current and low screen voltag gives a transconductance sufficient t yield the desired gain. With the grid bias again around —1.6 volts, th screen voltage was found to be +11 volts. It was convenient to run the first stage screen divider from the same cathode follower that supplied th screen of the second tube. Duplication of screen divider currents is wasteful and the slight amount of regeneration which might exist as a result of th common divider is not enough to be a problem. It may be beneficial in raising the effective over-all negative feedback.

Coupling between stages is accomplished by the method most commonl followed in d.c. amplifiers—a resistiv divider is returned to a source of —30 volts, with the upper resistor bein bypassed for a.c. above a few cycle a second. Some designers prefer to us very small values of capacitance fo this bypassing, thus putting a sligh rise in the high frequency response o the amplifier to compensate for fallin off elsewhere. This seems to be of dubious merit, in most cases, since it doe not increase the internal gain of th amplifier except insofar as one lose gain in the midband in order to realiz an apparent slight increase at the hig end, and it complicates the matter o controlling the response at the hig end so that often one does not kno what particular value should be use for bypassing.

The output tube is a 6C4 cathode fo

power, operated across the whole 600 volts of the supply, with about 5 ma. of plate current. Following it is a resistive divider (22*K* and 1*K*) to attenuate the feedback voltage before it goes to the main feedback divider (20*M* and 2.2*M*). This double division means that when the input proper is connected to a source with output impedance low compared to 2.2*M*, the effective feedback voltage at the input grid is approximately 1/23 x 2.2/20, or about 1/200 of the output voltage of the amplifier. Thus the over-all gain is the inverse of this, or 200. The double division is an expedient made necessary by the fact that if one attempted to attain a voltage gain of 200 over-all with only a single division of the feedback voltage, using a 2.2*M*-input resistor, then the feedback resistor would become 440*M* in place of the present 20*M*. The highest value considered by the author to be practical for such purposes is 100*M*, and this was also the highest value within reach at the time of design. It is, furthermore, rather optimistic to expect to get 500 kc. response when one is using resistors of values greater than 100*M* without extraordinary precautions.

Capacitance across the 20*M* resistor, inevitable even though small, makes it necessary to shunt the 2.2*M* input resistor with a trimming capacitor (3-12 μμfd.). It may also, in some cases, be necessary to compensate the 22*K* and 1*K* divider in similar fashion. This is accomplished by putting a suitable pot, say 10*K*, and perhaps a 500-μμfd. capacitor in series across the 1*K* resistor, then adjusting the pot (and—if necessary for best results—changing to another value of capacitance) for best transient response. A 10-kc. square wave is about right. This compensating circuit is shown dotted in Fig. 2.

As the geometry of the actual amplifier makes such a great difference, it is difficult to predict every part value in advance, and the photographs of a model that works have been provided with the idea of showing one geometrical arrangement which has been carefully worked out.

In matters of construction, as the photographs show, the author strongly believes in liberal use of bakelite boards and in the use of turrets. This type of construction is usually only found in fairly expensive instruments, although it is becoming more common in the middle brackets, so to speak. There is a considerable advantage to the use of this technique in that replacement of the small parts is very easy, and—if the hollow-top type of turret (or terminal lug, as it is often called) is used—there is no twisting of resistor leads. By putting holes in the boards for tube sockets, using hole-saws rather than fly-cutters, and putting the hollow end or main body of the turret on the same side of the board as the tube pins, one is able to indulge in just about as much point-to-point technique as could be desired. At the same time, one has a very handsome and sturdily-built subassembly, with parts that can all be easily replaced. Contrary to past tradition, incidentally, the ends of the resistor leads which go to the tube sockets are not twisted around the pins. Provided that a good solder joint is made, using 60-40 solder, it is not necessary to go in for much twisting and mangling of the leads. After all, the very stout AN series of connectors, which are about as rugged as most people would normally need, merely use solder cups, without twisting or wrapping of leads; and in the far less onerous service which tube socket pins undergo, it would seem that merely pushing the leads into the holes and getting a good solder joint would suffice.

The partial bypassing of the first pentode plate to ground, whereby the plate load is tapped at about the 10% point and a 270-μμfd. capacitor hung from there to ground, is done for reasons of high frequency stability. If both stages are allowed to roll off at once at the high end, they will—together with the cathode follower stage—reach the 180° point well before the amplifier has run out of feedback, and oscillations will occur. The network at the first plate merely insures that the plate-to-ground capacitance will appear across the 22*K* resistor, rather than across the whole 242*K*, in the region where the other parts of the amplifier are letting down. The 270-μμfd. effectively bypasses the main part of the 242*K* resistance in this region.

With no slope in the useful band greater than 6 db per octave, there is no chance of oscillation; and since the slope is so conservative, the high frequency response is very clean and free from peaks and dips, peculiar phase shifts, and so on. One cannot expect good transient response unless one controls the internal gain out to well beyond the useful band. The parts values are felt to be quite conservative, and the amplifier will not oscillate even for large departures from normal in gain of the individual stages, heater voltage, and component values. Power dissipated in tubes and components was in all cases held to low levels, well below ratings, and the life of each part should be long. No portion of the amplifier is working very hard.

The power supply is rather important. Two good electronic regulators are required, one for +300 volts at 15 ma. and the other for −300 volts at 5 ma. For the less critical d.c. applications, a VR tube system would suffice; and for uses involving a.c. amplifica-

(*Continued on page* 25)

Fig. 3. Bottom view of the instrument amplifier.

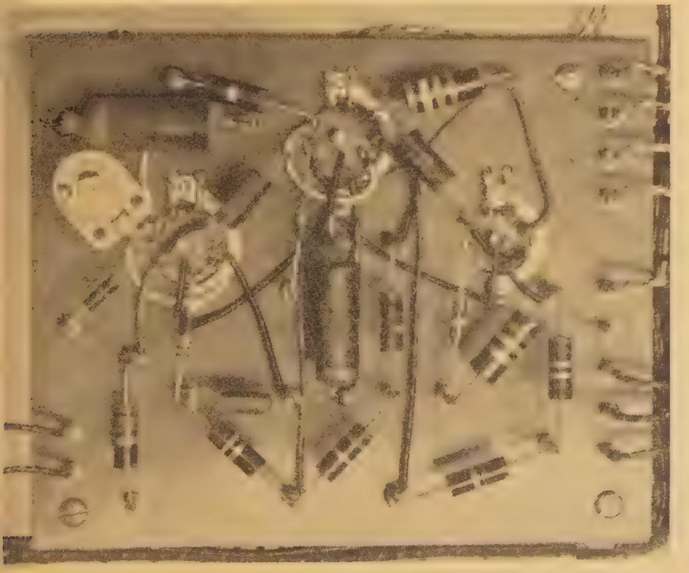
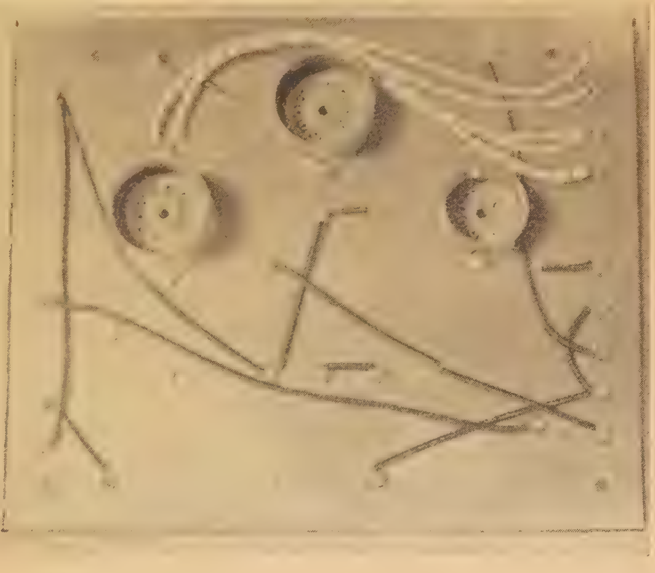
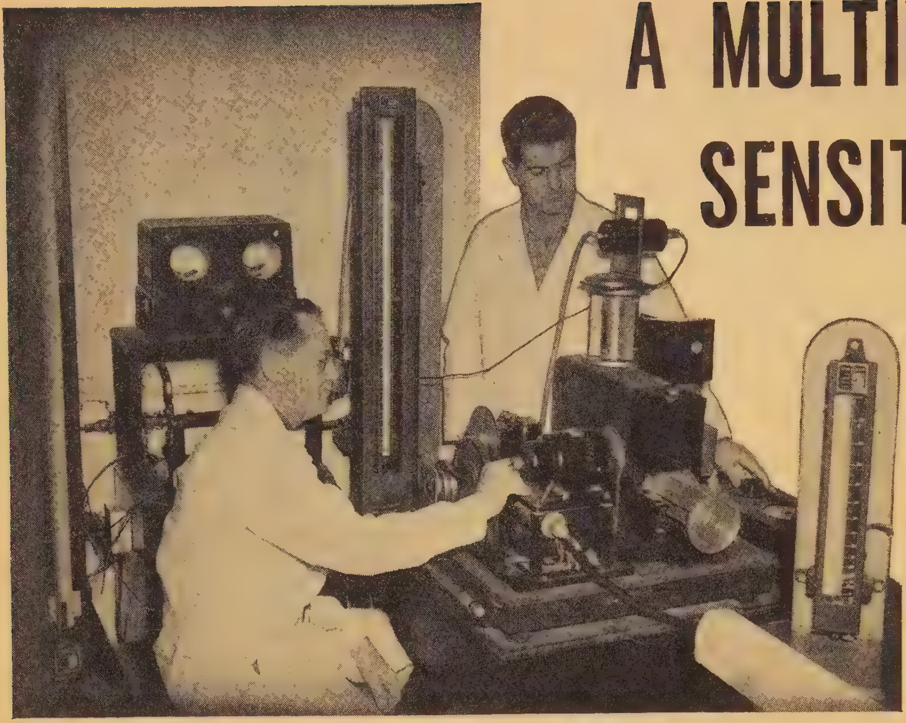


Fig. 4. Top view, showing the heater wiring.



A MULTIRANGE SENSITIVE CONTROL



The control being given a vibration shake-down test by the authors.

By

WINSTON ALDERSON and DOUGLAS ERICKSON

Development Laboratories, Ryan Aeronautical Company

A sensitive photocell-actuated control for use with instruments utilizing a low torque shaft.

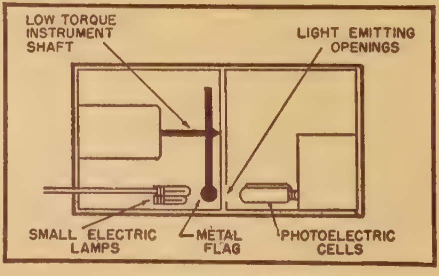
IN THE Development Laboratories of the *Ryan Aeronautical Company*, a new multirange sensitive control has been designed which is expected to have wide usefulness in industrial and commercial fields. Invented by the authors, this device is completely positive in operation, is practically unaffected by vibration and temperature change and, most important, will respond to the smallest measurable changes in conditions without detracting from the sensitivity or accuracy of monitoring instruments.

Basically, the device is a sensitive control actuated by a low torque instrument that controls the light source for a photoelectric cell. The cell is connected to a vacuum tube amplifier and a sensitive relay which can transmit a signal to various electrical or electronic apparatus.

The principal objective of the development was to produce a multirange sensitive control of this class which could be operated by various instruments such as sensitive altimeters, air speed indicators, tachometers, pressure gauges and other similar instruments utilizing a low torque shaft. Because of the inherent characteristics of such instruments, one of the prime requisites of the control was that it should not impair the accuracy or sensitivity of the instrument to which it would be coupled by inducing inertia into the system. Another important consideration, influencing its application to aircraft installations, was that the control be capable of withstanding vibration and temperature change without loss of accuracy or function as well as being suitable for use over a wide range of measurement and with a variety of instruments.

Typical aviation uses for such a sensitive control would be the automatic control of speed, altitude and direction of aircraft in flight. Coupled with a standard air speed indicator, this control is capable of maintaining the speed of an aircraft within five miles per hour without supervision. Because it is compact, lightweight, and can be attached directly to standard instruments, it is very well adapted for use with light planes, uninhabited or pilotless aircraft and missiles. Used with standard altimeters or tachometers, the device will automatically control plane altitude or engine speed within narrow limits and with positive action.

Fig. 1. Sketch of the control unit.



In addition to the basic functions which the control can perform, it may be harnessed to many other electrical devices to accomplish almost any task which should be performed under conditions that are measured by low torque instruments. For instance, it can automatically raise or lower aircraft landing gear and open and close engine cowl flaps at specified temperatures and speeds.

Because there is no mechanical linkage between the control and the instrument, this device is especially adaptable for use with instruments designed to indicate very slight changes in conditions, such as pressure gauges. It will respond to a pressure change of only one-tenth of an inch of water, or about the pressure of a normal exhalation of breath, without affecting the accuracy of the measuring instrument.

The unit consists of two tiny electric lamps, placed adjacent to each other, two photoelectric cells, a vacuum tube amplifier and two sensitive relays. The entire control apparatus is contained within a compact, cylindrical metal case measuring 4" in length and 3" in diameter.

Within the control body, the elements are separated by a metal partition in which two small, circular openings have been cut. These openings are light-emitting windows for the purpose of allowing light from the electric lamps to impinge upon the photoelectric cells. The small electric lamps are located on one side of the partition and the photoelectric cells are situated on the other side in such a way that the lamps, light windows and cells are in direct lines of sight.

When the control is attached to an instrument, a single modification is ade in the instrument: the rotating ointer is removed and a small, counter-alanced metal flag is substituted. This ag is designed so that it can pass etween the light sources and the light-nitting windows to obscure the light hich is directed to the photoelectric ells. (See Fig. 1.)

To illustrate the operation of the ontrol, a hypothetical case will be ssumed in which the speed of a pilot-ss missile is to be automatically aintained within a range of 400 to 25 miles per hour. (It might be in-eresting to note that the control is apable of maintaining this velocity etween much closer limits.) The con-rol body is attached to an air speed ndicator and the flag is located between tops set at 400 and 425 mph. The con-rol's relays are connected to throttle egulators which will influence the lane's velocity.

To engage the control, the lamps are witched on. If the speed of the missile s below 400 mph, the light from one of he lamps will pass through the window nd impinge upon one of the photo-ells. This cell reacts by generating a mall current which is amplified by he vacuum tube, and the resultant ignal actuates a relay to increase he speed of the missile. This condition shown in Fig. 2A) obtains as long s the speed of the missile is below 05 mph. When the velocity goes above his speed, the pointer flag rotates and bscures the light from both lamps so hat neither cell is activated (Fig. 2B). f the missile speed increases to 425 nph, the pointer flag rotates further, al-owing the light from the other lamp to trike the other cell, thereby causing his cell to transmit a signal which perates to reduce the plane's speed Fig. 2C). When the speed falls to 20 mph, the flag again covers both ight-emitting windows and no signals re sent to the missile's speed-governing pparatus (Fig. 2D). Consequently, here is a null area of 20 mph in which he control does not operate. Once the lag enters this null area, the missile peed must either rise to 425 mph or rop to 400 mph before a signal is enerated. In either case, the signal ontinues over a 5-mph margin before easing. This relieves the control of onstant performance and gives better tability to the missile's flight. By imply varying the size of the flag, it s possible to alter the differential of he device. To change the range, it is ecessary merely to rotate the control vith respect to the instrument.

It is also possible to use the control o cause a single event to occur with ositive reliability and without inter-nittent response from oscillating instru-nents. In this application, the control s used with two lamps, one photocell and a single light-emitting window (Fig. 3B).

One of the two lamps is switched on and the instrument is set in operation (position 1, Fig. 3A). The light from this lamp passes through the window and strikes the cell, causing it to transmit the required signal. This condition obtains until the instrument's pointer flag rotates to a position in front of both lamps and directly in front of the window. At this point (position 2), the light is cut off from the lamp and the cell reacts. The relay then signals the servomechanism, switches on the adjacent lamp and extinguishes the original lamp. As the pointer flag rotates in the opposite direction, it uncovers the window and allows the light from the burning lamp to strike the photocell (position 3). Immediately, the original sequence is again set up in which the cell reacts to transmit the original signal and the relay extinguishes the second lamp and switches on the original lamp.

In this application, the control will operate within a predetermined differential with positive action. Oscillation of the instrument's flag will not cause intermittency of response from the control. By varying the distance between the lamps and the size of the flag, extremely sensitive perception of this differential can be realized.

With the control utilizing two photocells, it is possible to achieve amazingly accurate altitude control of flying aircraft by means of a simple modification. Tests have shown that a fast-flying aircraft can be held to within ten feet of a specified altitude under normal atmospheric conditions by means of this arrangement.

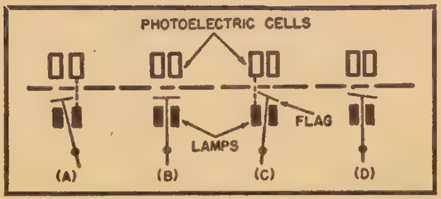


Fig. 2. Operational sequence of the control when dual photocells are used.

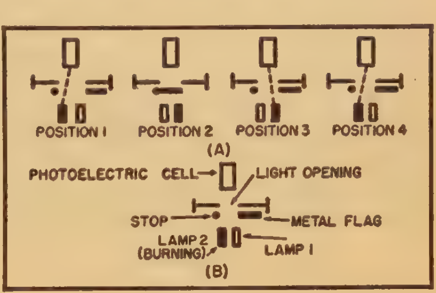


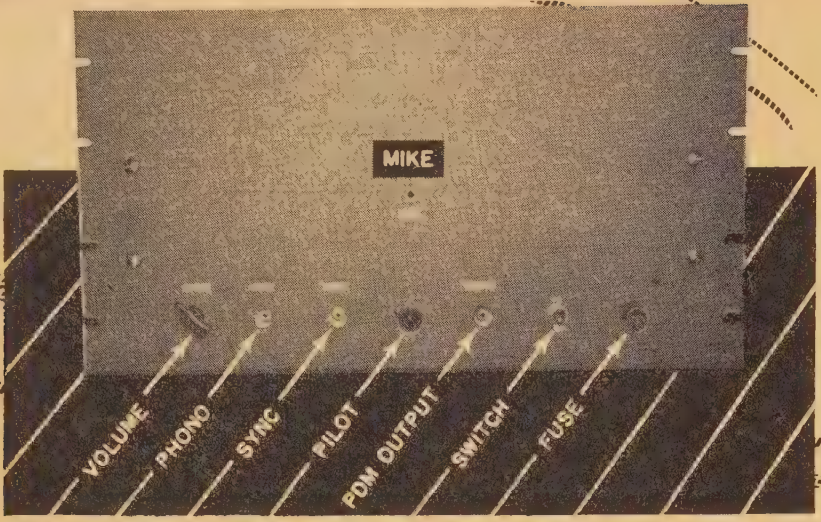
Fig. 3. Operational sequence of the control used with a single photocell.

The *Ryan* Development Laboratories have tested the control for reliability under conditions of vibration and temperature change. Over a temperature of 189°F., the accuracy of the device was affected less than 1%. In vibration tests, with 55 cycles at .030" amplitude, the control was accurate within a margin of 2%.

Other advantages of the control are its ruggedness, simplicity and low cost of fabrication. It does not require a high voltage power source but will operate on standard 24-volt d.c. current.

◆

The control as applied to an aircraft tachometer (left) and an air speed indicator.



Front view of experimental PDM unit arranged for rack mounting.

PULSE DURATION MODULATION

By **HENRY T. PERETKO**
Princeton University*

PDM characteristics are discussed, and details are given on an experimental modulator and demodulator.

THERE ARE many methods of modulation which come under the general heading of pulse modulation, some of which have shown great promise—and thus have been used extensively—and others which are in the developmental stage. It is generally accepted that the three major types of pulse sampling are:

1. Pulse amplitude modulation, or PAM, where the amplitude of the pulse is varied
2. Pulse code modulation, or PCM, where the signal amplitude range is divided into discrete levels and a group of pulses represents each signal level (The number of omissions and the particular pulses omitted in each group contain the information concerning the amplitude of the signal for that single group sample.)
3. Pulse time modulation, or PTM, where the time of the occurrence of some particular characteristic of the sampling pulse is varied

   Under the heading of PTM there is:
   - (a) Pulse position modulation, or PPM, where the time position of the pulse is varied
   - (b) Pulse frequency modulation, or PFM, where the recurrence frequency of the pulse is varied (Note that PFM is not suitable for time-division multiplexing.)
   - (c) Pulse duration modulation, or PDM, where the time of the pulse is varied

The last type is also referred to as pulse width modulation, or PWM, and pulse length modulation, or PLM. Moreover, it is evident that either edge or both edges of the sampling pulse may be varied, giving three other subdivisions under PDM.

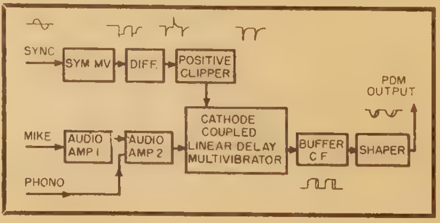
The character of the pulse modulation to be treated in detail here is such that the leading edges of the sampling pulses are equally spaced, having a time displacement equal to the repetition or recurrence time. The trailing edges, on the other hand, have a time displacement from their respective leading edges which is proportional to the amplitude of the modulating signal at the exact instant of the trailing edge. See Fig. 4.

Experimental System

Simple *RC* differentiation of the stabilized symmetrical plate-coupled multivibrator output and positive clipping with an efficient germanium diode yield negative triggers of relatively short time duration which have a fixed time displacement of 100 microseconds. These triggers are used to drive the linearized cathode-coupled gate, which is the heart of the pulse width modulator used in the experimental system under discussion. A block diagram of the system is shown in Fig. 1.

By merely using *RC* coupling, since the grid is never driven positive, the audio signal from the audio preamplifier is injected into the biased grid of the gate, yielding output plate pulses with fixed leading edges and modulated trailing edges. A cathode follower stage is used as a buffer and then the final inverted output is obtained from the shaper amplifier.

Fig. 1. Block diagram of experimental system suitable for pulse code modulation.



Most of the quantitative testing of the experimental unit was done by means of a *General Radio* wave analyzer, which acted as a highly tuned filter demodulator and yielded information on frequency content. Figure 3, however, shows the system which was used to monitor the demodulated output, for both phonograph and microphone, thus noting the quality of reproduction the system offered. The low-pass filter demodulator is shown in Fig. 2. It is this simplicity of demodulation that is inherent in PDM but lacking in PPM because of the extremely small amplitude of the audio component in the PPM frequency spectrum.

The 10-kc. rejection indicated in Fig. 2 is quite necessary since the repetition rate is 10 kc., making the 10-kc. term much larger in amplitude than the signal term itself. For example, if the ratio of the operating pulse width τ_0 to the repetition period T is .159, and the depth of modulation m is 10%, then the ratio of the amplitudes of the 10-kc. carrier term f_r to the modulating signal term f_m is 20:1. If τ_0/T is .159 and m is 100%, the ratio is 2:1.

As will be shown later, the audio component may readily be recovered by using the low-pass filter demodulator since there is no inherent harmonic distortion. However, the lower primary sideband terms result in distortion which limits the usable bandwidth generally, to slightly less than one-third the recurrence frequency. If, then

---

**This article is based on the author's Master' thesis, submitted to Princeton University on February 6, 1953.*

ese lower sidebands could be removed
parately at the receiver prior to low-
ss filter demodulation, the bandwidth
the signal might be raised to its
eoretically maximum value of $f_r/2$
d be completely free of any inherent
tortion. To achieve this, it would be
cessary to convert the PWM wave
ain at the receiver to a PAM wave
ain (whose only sidebands are a pair
primary sidebands, as with AM)
ior to low-pass filter demodulation.
ough some slight tube distortion
ght occur due to the conversion, this
chnique would result in a communica-
n system with no inherent distor-
n but with the noise-cleaning charac-
istics of an ordinary PDM system—
ich would usually include a slicer
this purpose.

ectral Analysis

One perfectly general approach to
e problem of spectral analysis of a
lse-duration modulated wave train is
express the pulse train as a continu-
s function of frequency by means of
e Laplace transform or the Fourier
egral, but the final result is a com-
cated expression which is difficult to
pand—since the actual system yields
ine spectrum solution. Another meth-
of attack is to generalize the expres-
on as a function of time obtained by
aking a Fourier series analysis of a
lse train that is periodic after a few
lses; but this, too, becomes quite in-
lved as it is very difficult to extract
e separate frequency components that
ll exist. Moreover, the expression is
o unwieldy to handle cases where the
lse train is almost periodic due to
f_m not being integrally related.

Since the solution is known to be a
e spectrum or a discontinuous func-
n of frequency, it seems logical to
e the trigonometric form of the Fou-
r series. The method of analysis to be
ployed, then, is simply to express the
) of one pulse by means of the
urier series and then, in the limits
integration for A_n and B_n, to insert
r τ its value as a function of time,
suming a simple sinusoidal modula-
n of:

$$t) = \tau_0(1 + m \sin \omega_m t)\ \mu\text{sec.}$$

here: τ_0 = operating width or unmodulated pulse width in microseconds
$T = 1/f_r$ the repetition period in microseconds
A = amplitude of the pulse in volts
ω_m = the modulating angular frequency
m = % modulation of the operating width, τ_0

mpletion of this analysis leads to the
equency spectrum of Fig. 5. The pre-
minant components are:

1. D.C. term	d.c.	$E_{d.c.}$
2. Modulating frequency term	f_m	E_m
3. Repetition frequency term	f_r	E_r
4. Lower primary sidebands	$f_r - kf_m$	$E_{s.b.}$
5. Upper primary sidebands	$f_r + kf_m$	$E_{s.b}$
6. Harmonics of repetition frequency term and its sideband terms	$nf_r \pm kf_m$	

where: n = order of harmonics of f_r
k = order of harmonics of f_m
n and k = 1,2,3,. . . . .

Of course, for the mathematical analysis, linear modulation and rectangular pulses of constant amplitude are assumed. Any discrepancies that arise due to these assumptions will be discussed later. The amplitudes of the components are:

$$E_{d.c.} = \frac{A\,\tau_o}{T} \text{ d.c. volts}$$

$$E_m = \frac{A_m\,\tau_o}{\sqrt{2}\,T} \text{ r.m.s. volts}$$

$$E_{rn} = \frac{A}{\sqrt{2}\,\pi\,n} \text{ r.m.s. volts}$$

$$E_{s.b.n.} = \frac{A}{\sqrt{2}\,\pi\,n} J_k\left(\frac{2\pi m n \tau_o}{T}\right) \text{ r.m.s. volts}$$

and for $n = 1$, where $\delta = \dfrac{2\pi m \tau_o}{T}$

$$S_k = \left|\frac{E_{s.b.}}{E_m}\right| = \left|\frac{J_k(\delta)}{\delta/2}\right|$$

See Fig. 6 for a plot of S_k vs. δ.

It is interesting to note that the spectral analysis of a PDM wave train with variable leading edges results in exactly the same expression as that which was obtained when the trailing edges were considered variable. The proof of this is very simple and perhaps intuitive. The only difference is that the limits of integration go from $(T\text{-}\tau)$ to T rather than 0 to τ; and since T is fixed, C_n is still the same.

Spectral analysis of a PDM wave train with both edges variable yields a

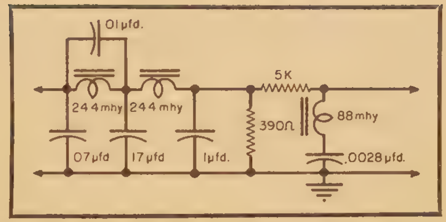


Fig. 2. The low-pass PDM filter demodulator with 10-kc. rejection.

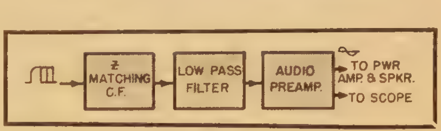


Fig. 3. Block diagram of monitor.

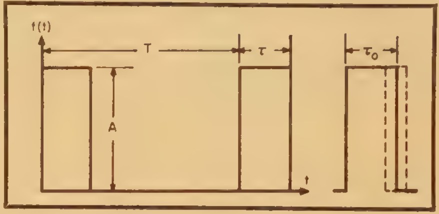


Fig. 4. Typical PDM wave train with various characteristics identified.

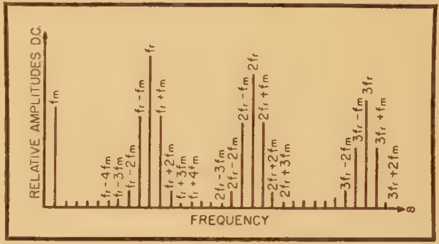
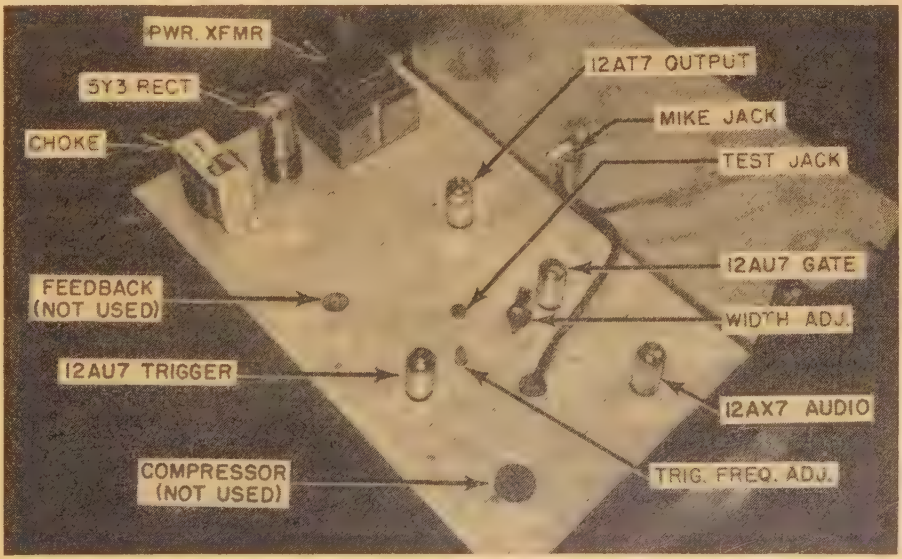
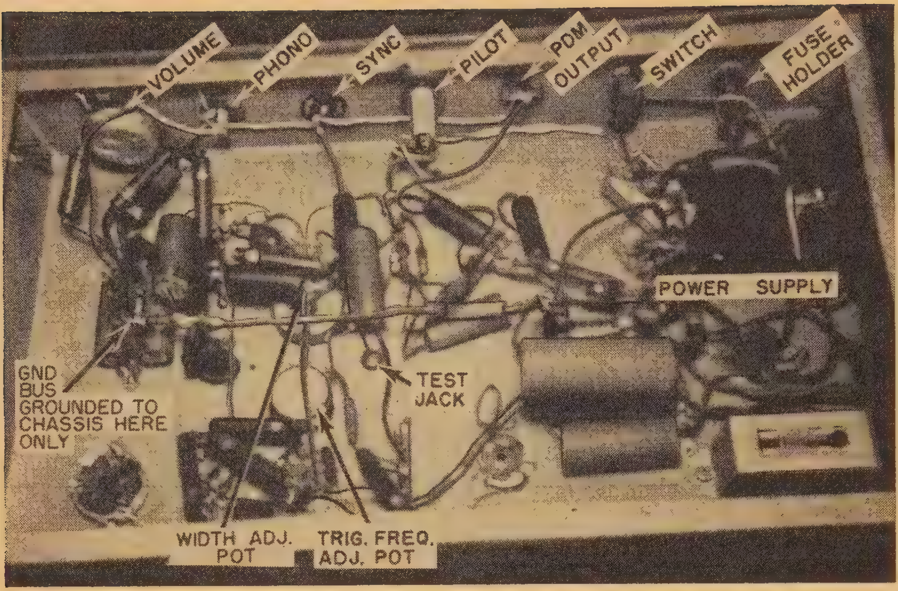


Fig. 5. A few of many spectral lines which may appear with PDM.

Top view of the experimental chassis with various components identified.





Bottom view of the experimental chassis with various components identified.

separate spectrum for each side of the pulse; if the same modulating signal is fed out of phase, resulting in the pulse spreading out from the center at the same time, two times the single spectrum will be obtained.

Step Curves

The theoretical sideband distortion step curves (Fig. 7) represent the inherent total distortion the system will have as the upper cutoff frequency of the modulating amplifier is increased. The steps up to 2 kc. are not shown, since the magnitude of S_4 is quite negligible under 50% modulation. At 2.5 kc., S_3 suddenly enters the signal band and a jump in total distortion

$$(S_T = \sqrt{(S_3)^2 + (S_4)^2 + -----})$$

appears, whose magnitude varies with the value of m. At 3⅓ kc., another integral submultiple of the repetition frequency, S_2, is included and another jump appears. In order to avoid the inclusion of S_2, then, a frequency of 3.2 kc. was selected as the maximum signal frequency to enter the linear delay multivibrator.

Fig. 6. Plot of the primary lower sideband amplitudes relative to the modulating signal for pulse duration modulation for $f_m = 1000$ cps.

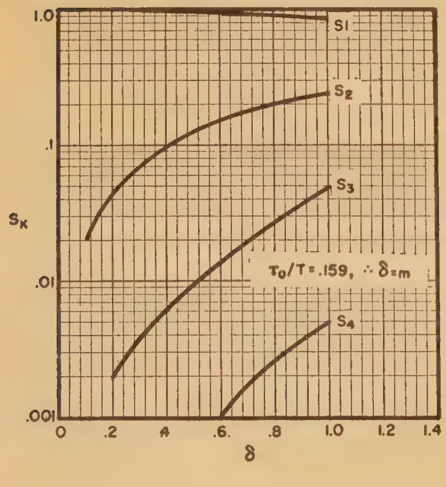


Figure 10 shows the cathode-coupled linear delay multivibrator circuit. For a typical medium-mu triode like the 12AU7, the time duration τ of the output plate pulse is:

$$\tau = R_{g2}C \ln \left\{ \frac{E_{bb} - E_{k2} + I_{b1} R_{L1}}{E_{bb} + E_{c0} - I_{b1} R_k} \right\} \mu\text{sec.}$$

where the only variable is:

$$I_{b1} = \frac{E_{bb} + \mu E_{g1}}{(\mu + 1) R_k + R_{L1} + r_p} \text{ ma.}$$

or $\tau = A + BE_{g1}$ µsec., indicating a linear relation between τ and E_{g1}. The resulting d.c. linearity curves are shown in Fig. 8. The experimental d.c. linearity curve exhibits a saturation effect at low widths since the trigger width is not negligible and limits the minimum modulated pulse width. In Fig. 9, the effect of varying E_{g1} on the various multivibrator waveforms can be seen.

Limited Bandwidth Distortion

The theoretical spectral analysis was based upon a pure PDM wave train having perfectly rectangular pulses. The fact that the output pulses were rounded did not pose a particularly serious distortion problem, for this modulator has a bandwidth-repetition frequency ratio of

$$BW/f_r = \frac{70\ kc}{10\ kc} = 7$$

which is an adequate high-frequency response and results in negligible distortion[1].

Generally, a slicer would be used in the receiver, and thus the bandwidth would be effectively increased again due to the resquaring of the pulses. Th
would almost completely suppress li
ited bandwidth distortion and at t
same time suppress the major porti
of noise picked up between the tran
mitter and receiver.

The limitation of the band with r
gard to low frequency response[1] pr
duces phase shift in the signal fr
quency term, but this phase shift
negligible for PDM.

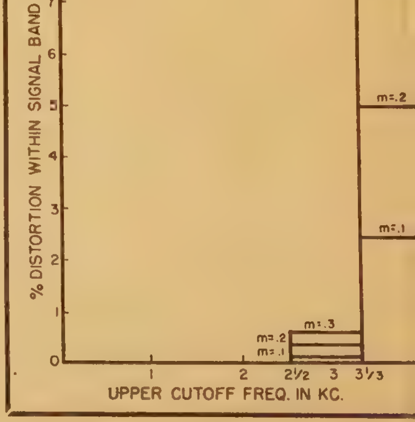
Bandwidth distortion would not be
problem in PPM since the amplitu
of the signal term is quite small (a
not constant)[2], and recovery of the si
nal is not attempted solely by mea
of a low-pass filter but rather with
bandpass filter tuned to the carri
frequency, and with a discriminat
as in FM. Another method of demod
lating a PPM wave train, howeve
does involve conversion to PWM, a
then low-pass filter demodulation.

Design Features of System

In this experimental system, the a
dio cutoff frequencies of the input aud
amplifier were selected to reduce t
amount of lower sideband distorti
entering the signal band. The upp
cutoff frequency f_2 was adjusted
3200 cps by shunting a capacitor fro
plate to ground. This was done to avo
the inclusion of S_2, the second low
primary sideband term, into the sign
band. As shown in the step curves
Fig. 7, this keeps the distortion dow
very low. The lower cutoff frequen
f_1 was adjusted to 142 cps, whi
does not disturb the articulation mu
but helps greatly in reducing ove
modulation caused by strong bass ton
of short duration.

Only 10% or 20% modulation is a
vised in order to satisfy a maximu
allowable total distortion of less th
1%. This is on the safe side, but it
lows for possible intermodulation di
tortion which might bring the tot

Fig. 7. Step curves of % distortion within signal band vs. upper cutoff frequency of modulating amplifier.



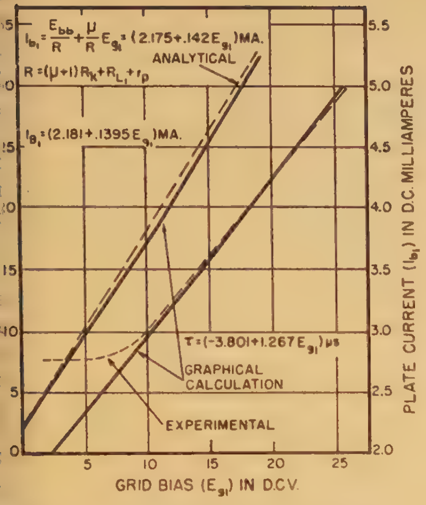


Fig. 8. D.C. linearity characteristic of the cathode-coupled delay multivibrator.

istortion up to 5%—considered as be- ıg still satisfactory for general broad- isting.

A repetition frequency of 10 kc. was elected to give an adequate signal andwidth. In telephone work, 8 kc. is enerally used; but this would force down to about 2700 cps. Actual f_r adjusted according to the fidelity esired.

The operating pulse width τ_o was elected for best linearity since a small ercentage of modulation is used. τ_o is ade about 15 or 20 microseconds to llow for three other channels for further multiplexing.

The shaper cutoff frequency f_s was djusted for 70 kc. so that $f_s/f_r = 7$, hich is high enough to result in neggible limited bandwidth distortion and et requires a smaller bandwidth in ansmission.

Trigger pulse width is generally ade very small, but to avoid a comlicated circuit, the width was made maller than the minimum excursion f the modulated pulse for $m = 30\%$, ius preventing saturation and the ocurrence of amplitude modulation.

The symmetrical plate-coupled mulvibrator was designed to yield a stable igger source of rapid switchover and ise time.

The delay multivibrator was linearzed by experimentally determining uitable values for R_{L1} and R_k. Theoretally, $R_{L1} = .855 R_k$ for minimum armonic distortion. To avoid stray ickup, leads were kept short and off ne chassis, and shielded leads were sed for the input jacks. To avoid round loops, a solid copper ground us was used which was only grounded nce to the chassis at the earliest stage f the modulator—the mike preampliier stage.

Since the d.c. load current is essenally constant at about half full load, was not necessary to use a regulated supply. Adequate filtering (a ripple voltage of approximately 15 mv.) and customary precautions were used to minimize the introduction of hum into the modulated output.

Separate phonograph and microphone inputs permit isolated mixing with sufficient gain (32.3-db phono gain and 67-db mike gain at maximum output) on either input to give 100% modulation.

Advantages and Disadvantages

The main advantages of PDM may be summarized as follows:

1. It is the easiest to demodulate in comparison to all other systems.
2. Time-division multiplexing is available for multiple-channel telephone and telemetering applications, to mention but a few. This is true also for other pulse systems (except PFM) but not for AM and FM, which must resort to frequency-allocation multiplexing.
3. Noise cleaning is achieved by using a slicer prior to demodulation.
4. Theoretically distortionless reception may be had if sliced PDM is converted to PAM, and then demodulated, thus eliminating lower sideband distortion.
5. PDM utilizes transmitter energy more effectively due to the sampling process than continuous-duty AM and FM systems.
6. There exists simplicity of circuitry and components compared to PCM and PPM as opposite extremes of complexity.
7. There are no quantizing noise considerations as in PCM.
8. PDM can be sliced and reamplified at each repeater station to keep the S/N ratio above a given minimum threshold level more readily than

(*Continued on page 27*)

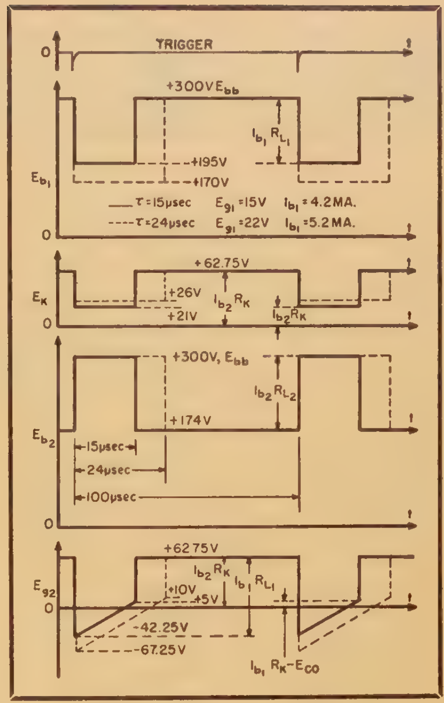


Fig. 9. Calculated waveforms in the delay multivibrator circuit.

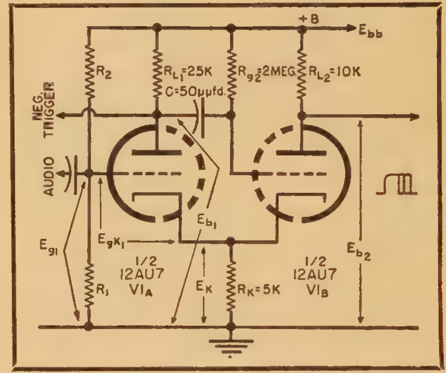
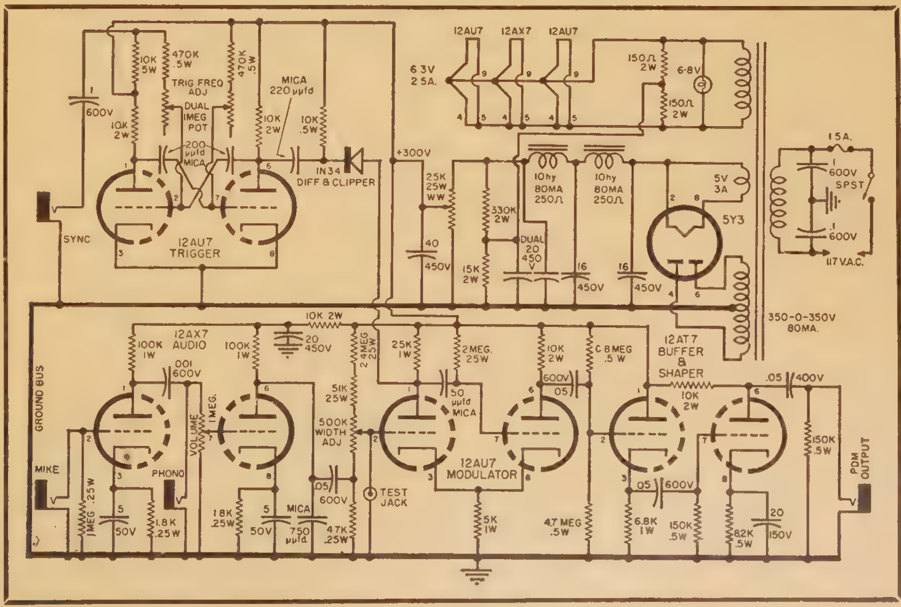


Fig. 10. The cathode-coupled linear delay multivibrator as used in PDM

Circuit diagram and parts values for the experimental PDM system



PHASE ANGLE MEASUREMENTS AT A.F

Accuracies of 2% at frequencies of 20 cps to 100 kc. are realized with this simple measurement technique.

By **ROBERT C. MOSES**

RECENT advances in the field of servomechanisms and the increasing application of specialized communications techniques have brought about renewed interest in the problem of how to determine accurately the phase angle between two a.c. voltages in the audio and ultrasonic frequency ranges. While many excellent phasemeters are obtainable commercially, the need frequently arises for a simple and precise method of phase difference measurement where such equipment is not readily available. This article describes one such technique capable of satisfying the above requirements and well adapted to routine laboratory application.

Phase angle measurements which require visual analysis of circular or elliptical oscilloscope patterns are at best only approximate, because of the difficulty of accurately evaluating the respective ordinate dimensions at phase angles differing appreciably from 0° to 180°. Errors resulting from parallax, astigmatism, and screen curvature frequently render measurement to better than ± 10° very difficult. It is, however, relatively simple to determine precise 0° or 180° phase relationships, since the corresponding patterns converge to straight lines which become superimposed when the exact in-phase or out-of-phase condition obtains. This forms the basis of a simple phase measurement technique in which the accuracy obtained may be substantially better than 2° over a frequency range of 20 cps to 100 kc. The essential elements of this measurement are shown in block diagram form in Fig. 1.

Figure 1 resembles the conventional oscilloscope phase-comparison method, except for the incorporation of a precision phase-shifting element between the signal source and the device under test. The function of the precision phase shifter is to provide a constant-amplitude output voltage, the phase angle of which—with respect to its input—is accurately determinable and capable of continuous variation over a range of 0° to 175°. This is accomplished by means of calibrated variable resistance and capacitance elements of known accuracy. By introducing an appropriate compensating phase shift between the signal source and the device under test, such that the over-all phase angle is returned to zero, the equivalent phase shift through the latter may be evaluated to a degree of accuracy dependent only upon the calibration accuracy of the phase-shifting network. Using standard components of known value, measurements to better than 2% up to 100 kc. may be readily obtained.

Because the precision variable phase shifter constitutes the "heart" of the measurement technique, a brief description and analysis of this element may be in order.

Referring to Fig. 2A, if a series resistance-capacitance network is fed from a constant voltage source E_A and an output E_o taken across the resistance element of the network, the phase angle between input and output voltages may be expressed by:

$$\phi = -\tan^{-1} \frac{1}{\omega CR} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

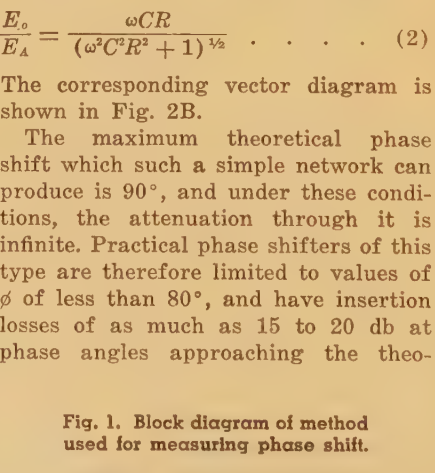
and their relative amplitudes by:

$$\frac{E_o}{E_A} = \frac{\omega CR}{(\omega^2 C^2 R^2 + 1)^{1/2}} \quad . \quad . \quad . \quad . \quad (2)$$

The corresponding vector diagram is shown in Fig. 2B.

The maximum theoretical phase shift which such a simple network can produce is 90°, and under these conditions, the attenuation through it is infinite. Practical phase shifters of this type are therefore limited to values of ø of less than 80°, and have insertion losses of as much as 15 to 20 db at phase angles approaching the theoretical maximum. Because the attenuation increases with the phase shift, E does not remain constant with variations in the network values. This together with the restricted range o phase shift obtainable, imposes seriou limitations upon the use of a serie RC network of this type for the application at hand.

Fig. 1. Block diagram of method used for measuring phase shift.



If the source E_A is split into two 180 components of equal amplitude, and th output voltage E_o taken between th electrical center of the source and th junction of R and C as in Fig. 2C, i can be shown that the resulting phas angle α between E_o and one componen of E_A will be exactly twice the angl ø as defined above, while that betwee E_o and the other component of E_A wi be 180° — 2ø. It can be shown furthe that the output voltage E_o will remai constant regardless of the discree values assigned to ω, R, and C, provide only that the components of E_A remai equal and in 180° phase relationshi This will be made clear by reference t the vector representation of Fig. 2D The locus of the intersection of th quadrature vectors E_R and E_C describe a semicircle about the midpoint of th vector E_A as the impedances R and are varied. It follows, therefore, tha a vector E_o connecting the midpoint o E_A with any point along this locu will be of constant magnitude $E_A/$ and will make a varying angle wit the vector E_A. The corresponding phas and amplitude relations may be expressed by:

$$\alpha = 2\phi = 2\left[-\tan^{-1} \frac{1}{\omega CR}\right] \quad . \quad . \quad . \quad (3$$

$$E_o = 0.5 E_A \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4$$

E_o being constant for zero source an infinite load impedances.

In practice, Eqt. 4 holds to a clos approximation if the source impedanc is very much lower than the equivalen impedance of the RC network and th load impedance exceeds about fiv times the latter.

A practical phase shifter based upo

e above principles may be made to ovide up to 175° of phase shift with ss than 10% change in output voltage er a frequency range of 20 cps to 100 . However, in order for Eqt. 3 to be mpletely valid, it is essential that the vo components of E_A maintain an xact 180° phase relationship and equal nplitude over the entire band of inrest. Furthermore, it is important that e source impedance remain constant ith frequency and be low with respect the minimum impedance of the *RC* etwork, and also that any loading on e latter be minimized.

A schematic diagram of the variable hase shifter is shown in Fig. 3. The vo components of the source E_A are erived from a balanced phase-splitting iode, one section of a type 12AY7. he effective over-all impedance of the urce is of the order of 2000 ohms. The ectrical center of the source is at a.c. round potential by virtue of a contant-voltage plate supply having an quivalent impedance of about 3 ohms. uch a supply may consist of batters or an electronic regulator, and is bsolutely essential in order to maintain ccurate balance and correct phase retionship between the two components f E_A. For the same reason, the plate nd cathode load resistors of the phase plitter are matched to 1%, and the ormer is shunted by a small trimmer apacitor to equalize the interelectrode nd stray circuit capacitances. The xact value of this trimmer may be etermined by adjusting for equal plate nd cathode output voltages at the highst frequency of interest; values of the rder of 4-5 μμfd. are typical for the verage tube and circuit configuration. he phase-shifting network operates nto a cathode follower comprising the ther half of the 12AY7. The cathode ollower presents an effective load impedance of over 5 megohms to the phasehifting network, and simultaneously solates the latter from the device under neasurement.

The phase-shifting elements *R* and are calibrated to 1% and together rovide an effective variation in *RC* roduct of over 10,000 to 1. If available, apacitor decades and nonreactive reistor decades of appropriate accuracy vill be found extremely convenient. able 1 gives a number of *RC* product alues together with the corresponding hase angle in degrees for several comnonly used frequencies. These figures vere derived from Eqt. 3, and will be ound sufficiently accurate for most ractical purposes. In selecting specific *C* combinations for a given frequency, t is recommended that the resistance be kept between the limits of 5000 hms and 1 megohm where possible.

It is important that the oscilloscope ised for determination of the 0° "null" oint have *X* and *Y* deflection amplifiers which themselves contribute a minimum amount of phase shift over the frequency range of interest. A scope of the wide-band variety is recommended. Alternatively, corrective measures may be incorporated whereby the reference phase is returned to zero at each frequency prior to making a measurement. These measures are provided by means of a variable resistor R_1 in series with the *Y*-axis input (Fig. 1). (In some scopes, R_1 may have to be placed in the *X* signal channel.) A switching system facilitates phase correction of the scope by impressing the same signal on both sets of deflection plates simultaneously. In operation, the switch is first set to "check" and the scope adjusted for zero phase shift if necessary by variation of R_1 and the gain controls. The switch is then set to "read", and the phase-shifter variables *R* and *C* are adjusted to return the phase angle pattern to zero. The net phase shift through the device under measurement may then be evaluated from Eqt. 3 or Table 1 for specific values of ω, *C*, and *R*. This procedure is repeated for as many frequencies as may be desired. For best measurement accuracy, the input to the phase shifter should not exceed 1 volt r.m.s, and overloading anywhere in the system as evidenced by curvature of the straight line pattern should be avoided. Interpolation between adjacent values of *R* or *C* can be effected by small changes in ω; however, it should be ascertained that any phase shift in the indicating instrument remains constant between the frequencies involved.

In a few cases, ambiguity as to whether an unknown phase shift is in the leading or lagging direction with

(*Continued on page* 21)

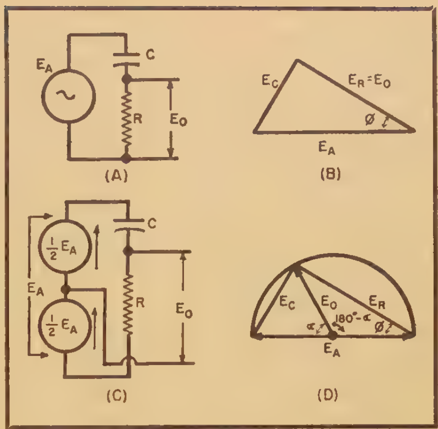
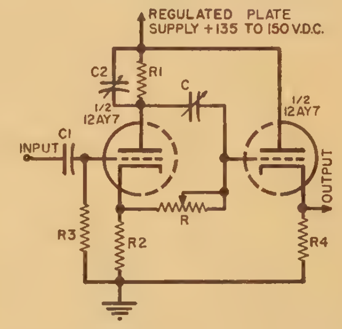


Fig. 2. (A) Conventional phase shifter and (B) vector diagram. (C) Basic principles of the new phase shifter, and (D) vector diagram showing relationships.



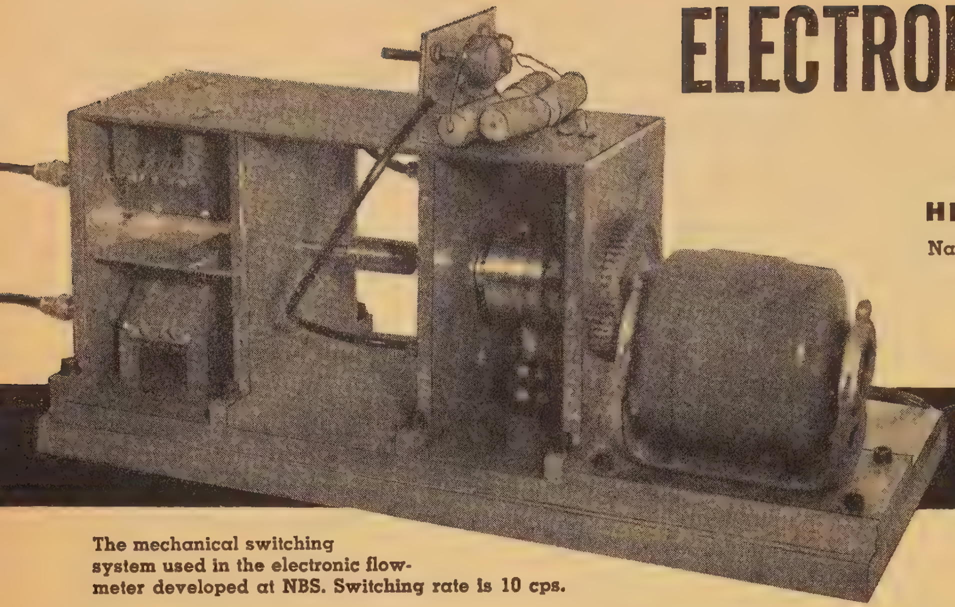
R—1000-100,000 ohm 1% nonreactive decade res.
C—100 μμfd.-.01 μfd. decade cap.
R_1, R_2—1000 ohm, 1 w. 1% wire-wound res.
R_3—1 megohm, ½ w. res.
R_4—10,000 ohm, 1 w. res.
C_1—0.56 μfd. cap.
C_2—1.5-7.0 μμfd. trimmer cap.

Fig. 3. Circuit diagram and parts list of the precision variable phase shifter.

Table 1. Tabulation of RC product values. Values above heavy line are expressed in kilohms-microfarads, below heavy line in ohms-microfarads. Values of R should be kept between 5000 ohms and 1 megohm where possible.

Frequency cps	Phase Angle; degrees lag					
	30°	45°	60°	90°	120°	150°
30	19.82	12.81	9.18	5.31	3.08	1.42
50	11.88	7.69	5.52	3.18	1.83	854.0
100	5.95	3.84	2.76	1.59	919.9	427.0
200	2.97	1.92	1.38	795.6	459.8	213.5
400	1.48	962.5	690.0	397.8	229.9	116.8
700	849.5	550.0	394.1	227.4	131.2	60.95
1*K*	594.7	384.5	275.9	159.2	91.99	42.70
2*K*	297.2	192.3	137.9	79.56	45.98	21.35
5*K*	118.8	76.88	55.18	31.83	18.34	8.54
10*K*	59.47	38.45	27.59	15.92	9.20	4.27
15*K*	39.59	25.61	18.38	10.61	6.12	2.84
20*K*	29.72	19.23	13.79	7.96	4.60	2.14
50*K*	11.88	7.69	5.52	3.18	1.84	0.85
100*K*	5.95	3.84	2.76	1.59	0.92	0.42

ELECTRONIC FLOWMETER



The mechanical switching system used in the electronic flowmeter developed at NBS. Switching rate is 10 cps.

By
HENRY P. KALMUS
National Bureau of Standards

A wide range of velocities of both gas and liquid flow can be accurately measured with this meter.

A NEW type of electronic flowmeter, capable of measuring the air currents in a still room or the rapid flow of fluids in pipes, has recently been developed at the National Bureau of Standards. This device utilizes the change in velocity of sound waves as a measure of fluid flow. It has a very fast response and does not obstruct the fluid currents in making a measurement. In addition, the signal-to-noise ratio is sufficiently high to permit the measurement of extremely small velocities.

Most of the present methods for measuring the velocity of flowing liquids depend on mechanical devices that usually introduce discontinuities in the fluid and have inherent inertia which prevents faithful reproduction of fast velocity changes. One type of flowmeter utilizes the principle of the homopolar machine; but this method cannot be used for gases, and the instrument is—at present—restricted to the measurement of conductive fluids. Another method makes use of the resistance change in hot wires placed in the path of fluid flow; however, besides presenting an obstruction to the flow, the hot wire is not generally applicable to fluids that would change chemically or physically as a result of the heat from the wires.

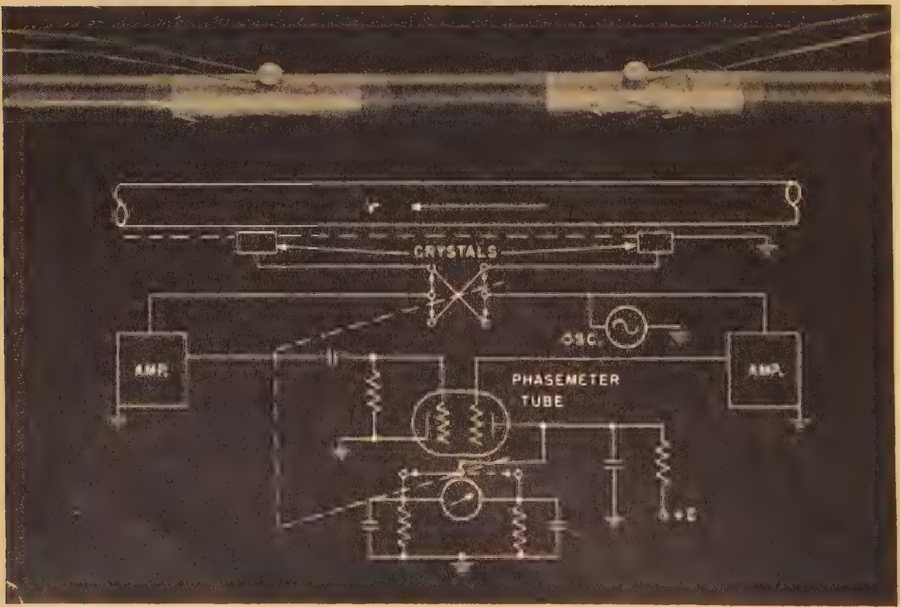
In the newly developed flowmeter, a sound wave is transmitted over a fixed distance through the flowing fluids, and the phase of the received wave is compared with that of the transmitted wave. The sound energy is imparted to and taken from the fluid through the walls of the containing vessel. No part of the measuring system need come in direct contact with the medium under study. This characteristic of the system **makes the unit applicable to the meas**urement of blood flow in the aorta and to the detection of the flow of chemicals in a closed system, e.g., the coolant in a chain reactor. Minor modifications will permit the measurement of the flow of such fluids as gas or oil in a metal pipe, or a determination of the relative velocity of a ship to that of the water through which it is moving.

In instances other than those involving extremely high velocities, e.g., in wind tunnels, a simple system utilizing merely a stationary device to transmit energy into the medium and another stationary unit to receive it would be impractical because changes in distance or propagation velocity would produce errors far greater than the variations due to flow. For this reason, the transmitter and receiver of the flowmeter are exchanged periodically without varying their locations. This is accomplished by using identical magnetostrictive or piezoelectric exciters—such as barium titanate crystals—as transmitter and receiver, and by switching their connections alternately to the receiving and transmitting channel. Thus, the phasemeter displays two phase shifts alternately, one a function of the sound velocity plus the fluid flow and the other a function of the sound velocity minus the fluid flow. The difference between the two phase shifts is a measure of the velocity of the fluid. The switching can be made to operate faster than the inherent variations occurring in either the transmitter or the receiver or even the medium. Hence, the variations will occur at a minimum of one complete transmitter-receiver switching cycle, and the phase difference will remain unaffected.

In the first experimental model of the NBS flowmeter, a mechanical switch

(*Continued on page* 27)

Typical crystal arrangement of the flowmeter (top) and circuit diagram (bottom).



SCILLOSCOPE VOLTAGE CALIBRATOR

Front view of the oscilloscope voltage calibrator. Note the "calibrating frequency" switch which makes this instrument unique.

By **ALVIN B. KAUFMAN**
Research Engineer, Northrop Aircraft Co.

This unit can provide a square-wave calibrating voltage at frequencies of from 1 to 20,000 cps.

WITH the advent of oscilloscope voltage calibrators, the measurement of the voltage amplitude of observed scillograph patterns has been vastly mplified. However, in the opinion of 1e author, the commercial units which re available on the market are not ompletely satisfactory either in price r in performance. For this reason, a implified calibrator has been designed hich has certain desirable circuitry ot available in any of the commercial nits and yet is inexpensive in design omponents.

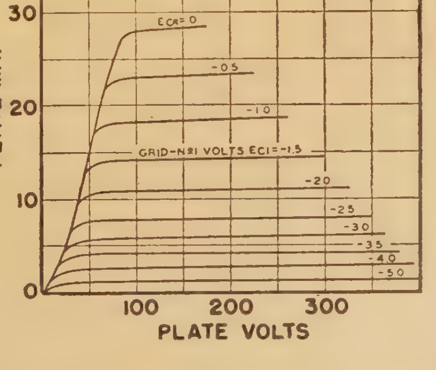
A prerequisite in the design of an scilloscope voltage calibrator, not met y all manufacturers, is that its refernced output should remain accurate ver a wide range of a.c. line voltage ariation. The circuitry described here 1eets this requirement. With this calirator, the line voltage may vary from 0 to 135 volts without any visible shift f the calibrating pattern on the oscilloscope. The calibrator's over-all acuracy is ± 4%; this accuracy may be 1creased to ± 1% by a minor mathmatical or engraving process which vill be discussed in greater detail furher on in this article.

All commercial calibrators are deigned to produce a square wave at ne frequency. Thus, ignoring any tilt f the pattern due to poor low freuency response in the oscilloscope, the eak-to-peak value of the pattern—at 0 cps—is used to determine the signal evel. Where the frequency of the sigal to be calibrated is considerably bove the line frequency, the oscillocope gain may have fallen off, and the ow frequency calibration may not be ccurate unless a scope-frequency corection factor is employed. Furthermore, there is always the nuisance of uggling sweep frequency dials down rom the test frequency to line freuency in order to secure a locked attern.

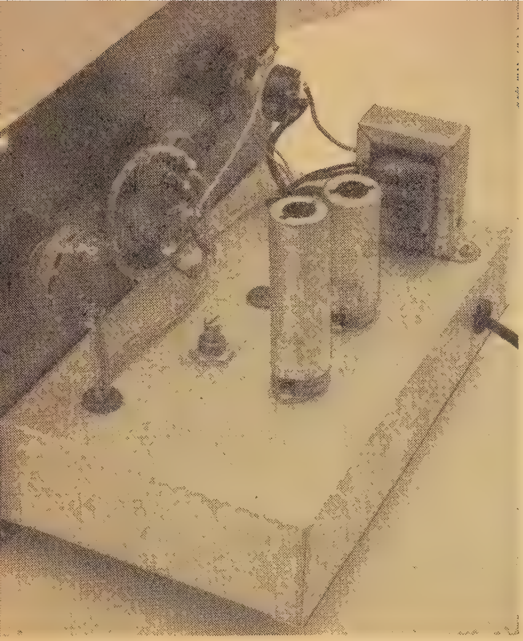
This simplified calibrator has proisions for the injection of a signal freuency voltage, between 1 cps and 20 kc., which sets the output frequency of the calibrator. A frequency calibrating signal voltage level between approximately 6 and 120 volts r.m.s. is required. The load on the signal source is 1 megohm and may in general be secured from some section of the circuit under test, with negligible shunting or loading effect. At low levels of external calibrating frequency signal voltage, the zero center (or average reference line) may shift, but the peak-to-peak amplitude will remain a constant over the whole range of calibrating voltage input noted.

The circuitry as shown in Fig. 2 is relatively straightforward, and relies in part on the constant-current characteristics of a pentode with fixed screen excitation. There are, however, a few points of more than casual interest concerning the design of the calibrator. Basically, the circuit consists of a pentode which is driven alternately between cutoff and plate current saturation. It is apparent from Fig. 1, a family of plate current curves, that for a fixed bias the plate current of the tube is substantially independent of plate voltage variation (if over 50-100 volts), and that a plate load resistor would develop an output voltage independent of everything except screen voltage. Heater voltage variation does not have an appreciable effect on peak-to-peak amplitude as such variation causes only minor changes in the plate current saturation and cutoff points.

Fig. 1. Average plate characteristics for a typical pentode—type 6CB6.



In practice, several changes had to be made in the original paper work design. The plate current curves are almost—but not quite—flat, and this caused the output to vary about 5% with change of plate voltage over the specified a.c. line voltage range. Thus, it was necessary to regulate both the plate and screen voltage. Almost all voltage regulation systems employ a gaseous regulator tube either for direct control or as reference control for a vacuum tube system. As the current drawn by the pentode clipper is only a few milliamperes, there was no need for a complicated voltage regulator, a VR tube being directly applicable. It is the use of this VR tube, however, which limits the high frequency output of the calibrator. The VR tube must regulate and hold the voltage across itself by changing the current it [illegible]ws. It is



Rear view of the oscilloscope calibrator.

subject to especially difficult regulation because of the fluctuating plate current of the pentode as it is driven between cutoff and saturation. As the calibrating frequency is raised, the voltage regulator cannot follow the plate current variation exactly; somewhat above 1 kc., the output becomes almost sinusoidal although holding its peak-to-peak value. At 20,000 cycles and above, the voltage regulator loses control, and the output voltage—due to paralysis of the VR tube—falls to a low value. The scope calibrator may be made useful up to much higher frequencies by the substitution of a battery power supply of adequate size and power-handling capacity to insure good regulation.

Selection of the VR tube to be used is important, as the many types available vary radically in their ability to regulate voltage. The OB2 has an operating voltage of 105; its regulation is 1 volt, or slightly better than 1%. The next best regulator tube has about 2% regulation variation. Use of the 105-volt regulator tube in this calibrator meant that it would be impossible to secure 100 peak-to-peak output volts. A VR-150 or two OB2's in series could be used at a reduction in regulation accuracy, but the power supply would become much more expensive and complicated. Therefore, it was decided to settle on 50 peak-to-peak output volts, which would allow a simple multiplier and peak-to-peak output scale. Output ranges are 100 mv., 1 volt, 10 volts, and 50 volts peak-to-peak, full scale.

The peak-to-peak linear taper output potentiometer may look peculiar, connected as it is from plate to ground. It would seem like much better design to use it as the plate load resistor. But if it were used as the plate load resistor, the wiper would move to the B + lead for zero square-wave output signal, resulting in the B supply ripple coming out as a "calibrating" signal. Excessive filtering would be required to eliminate this ripple. With the configuration used, the wiper moves towards ground for low-level output calibrating signals, producing a much better signal-to-noise ratio. The pentode tube effectively acts as a switch which shorts out the d.c. voltage across this output load every half-cycle of calibrating frequency. Direct coupling is used to insure constant calibrating level throughout the calibrating frequency range down to 1 cps or less. A coupling condenser between the pentode plate and load-output potentiometer does not give any desirable increase of performance, but limits the usable frequency range as noted.

Accuracy, so far, has been shown to be slightly better than 1%. Potentiometer loading error[1], however, causes the output potentiometer to be nonlinear (Fig. 3) by approximately 3%. This causes a possible over-all error of 4%. Potentiometer loading error occurs because the load resistor (in this case, the output multiplier) shunts the output resistance of the potentiometer so that a given rotation no longer represents a proportional resistance and voltage output. The error is always towards reduced output. Figure 3 shows the equation to use in calculating the loading error. When the output dial is engraved, the output level points may be angularly moved to compensate for this error, or a simple mathematical correction may be made in the dial reading when utmost accuracy is required.

The engraving used on this instrument may be purchased commercially by the letter. It is well worth the expense, making the difference between a professional and hand-hewn appearance. Alternately, it is also possible to use decals or name plates to advantage. For the potentiometer output dial, a 0-100 in 270°-rotation Mallory 369 dial plate may be used.

For engraving the panel, 30° angular rotation is employed between switch markings to correspond with the Mallory switches specified. Note that for

(*Continued on page* 31)

Fig. 2. Circuit diagram and parts values for the calibrator.

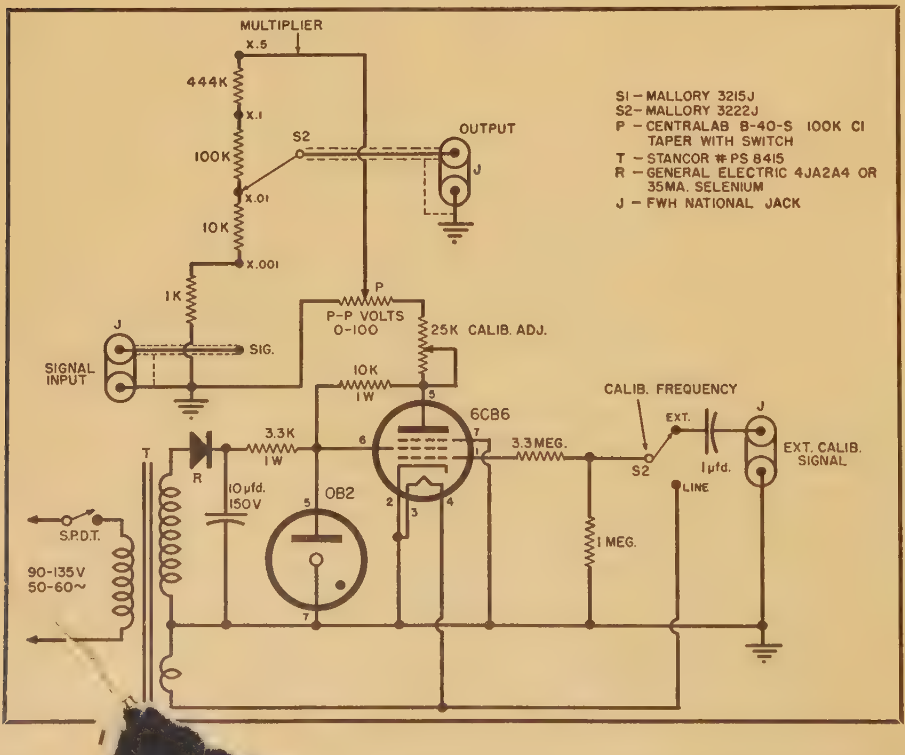
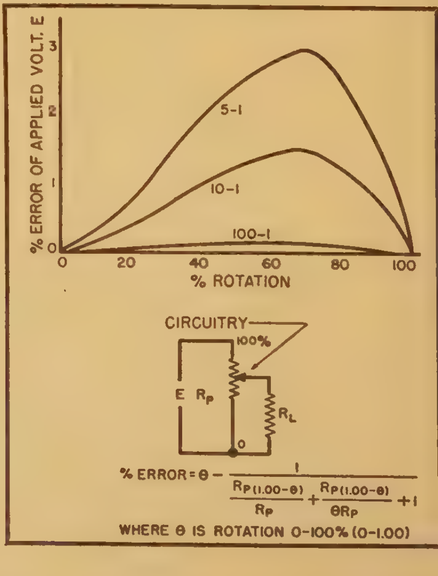


Fig. 3. Potentiometer error for various ratios of load resistance to potentiometer resistance. Error equation is given below.



$$\%\ \text{ERROR} = \theta - \frac{1}{\frac{R_{P(1.00-\theta)}}{R_P} + \frac{R_{P(1.00-\theta)}}{\theta R_P} + 1}$$

WHERE θ IS ROTATION 0-100% (0-1.00)

ENGINEERS:

DOES YOUR PRESENT JOB GIVE YOU

ALL THESE RCA CAREER ADVANTAGES?

CHECK SHEET

Yes No

☐ ☐ PROFESSIONAL RECOGNITION AND PRESTIGE?

☐ ☐ ADVANCEMENT IN STATUS?

☐ ☐ SECURITY AND STABILITY?

☐ ☐ CHALLENGE AND OPPORTUNITY?

☐ ☐ HIGH SALARY SCALE AND OPPORTUNITIES FOR PROMOTION?

☐ ☐ EXCELLENT SUBURBAN HOUSING AT REASONABLE COST?

☐ ☐ FACILITIES FOR PROFESSIONAL ADVANCEMENT?

☐ ☐ UNEXCELLED TECHNICAL AND LABORATORY FACILITIES?

☐ ☐ ASSOCIATION WITH TOP SCIENTISTS?

☐ ☐ TUITION REFUND PLAN FOR ADVANCED STUDY?

☐ ☐ MILITARY OR COMMERCIAL OPPORTUNITY?

☐ ☐ MODERATE COST OF LIVING?

☐ ☐ MODERN RETIREMENT PLAN?

☐ ☐ COMPANY-PAID LIFE INSURANCE?

☐ ☐ COMPANY-PAID LIBERAL HOSPITAL, SURGICAL AND DISABILITY PLAN (FAMILY BENEFITS)?

☐ ☐ LIBERAL VACATION PLAN?

☐ ☐ LIBERAL HOLIDAY SCHEDULE?

☐ ☐ PROFESSIONAL STATUS AND UTILIZATION OF YOUR EDUCATION AND EXPERIENCE?

POSITIONS NOW OPEN FOR SENIOR DEVELOPMENT AND DESIGN ENGINEERS:

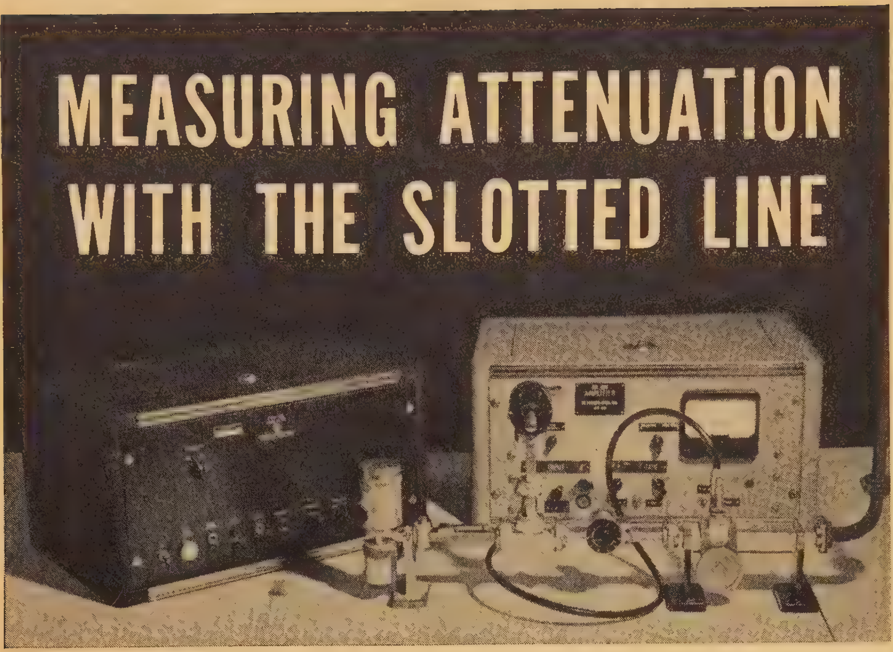
- √ ELECTRONIC . . .
- √ COMMUNICATIONS . . .
- √ MECHANICAL . . .
- √ COMPUTER . . .
- √ ELECTRON TUBE . . .

PERSONAL INTERVIEWS ARRANGED IN YOUR CITY. A copy of our booklet "Challenge and Opportunity," describing the role of the engineer in RCA, will be mailed upon request. Please send a complete resume of your education and experience to:

MR. ROBERT E. McQUISTON, Manager
Specialized Employment Division, Dept. 204G
Radio Corporation of America
30 Rockefeller Plaza
New York 20, N.Y.

RADIO CORPORATION of AMERICA

MEASURING ATTENUATION WITH THE SLOTTED LINE



Test setup for measuring attenuation with the slotted line.

By

A. V. DONNELLY

College of Engineering, State U. of Iowa

The VSWR of a test section with the far end shorted is used to determine the attenuation of the section.

THE determination of attenuation is probably one of the most often required measurements in the microwave region. Calibration of attenuators, determination of directional coupler characteristics, and standardization of power-measuring equipment are only a few of the techniques that directly or indirectly require attenuation determinations. Certain standard procedures are usually followed, most of them being based upon two general methods: (1) the power differential method and (2) the substitution method.

One of the most direct procedures is that of measuring the power input to a test section and determining the power output. The attenuation loss in decibels will then be equal to 10 log P_{out}/P_{in}. In the substitution method, a calibrated variable attenuator is substituted for the test section and varied until the same loss in power is noted. The insertion loss of the variable attenuator is then equal to the attenuation of the test section. Both of these methods have the disadvantage of requiring either two identical power meters or one single meter with extremely good stability.

A method of determining attenuation is hereby proposed which not only eliminates the need for a power meter or a standard variable attenuator but also results in an experimental procedure quickly performed with a minimum of equipment. The only equipment required is a microwave signal source, a standing-wave indicator, and a means of shorting the test section at its receiving end.

The experimental procedure required to obtain the necessary data is extremely simple and is identical to that encountered in standing-wave and impedance determinations. Figure 1 shows the block diagram of the equipment layout.

After the frequency of the oscillator has been adjusted to the desired value, the voltage standing-wave ratio (VSWR) is measured by means of the slotted line and standing-wave indicator. This value is then inserted in the equation:

$$\text{attenuation loss (db)} = 10 \log \frac{\text{VSWR}+1}{\text{VSWR}-1}$$

from which the required attenuation in db is directly obtained.

The above expression is based upon the relationship that exists between the reflection coefficient (K) and the voltage standing-wave ratio (VSWR) as:

$$\text{VSWR} = \frac{1-K}{1+K}$$

where:

$$K = \frac{Z_R - Z_o}{Z_R + Z_o}$$

In this latter equation, Z_R is the load impedance and Z_o the characteristic impedance of the line.

Table 1 (at the left) shows the attenuation loss directly in db for a given VSWR. Casual observation might indicate that the method has its limitations with respect to the range of attenuation that can be determined. However, a more thorough examination will indicate that the useful range in which the VSWR can be determined satisfactorily is very close to the useful range of attenuation encountered in actual practice.

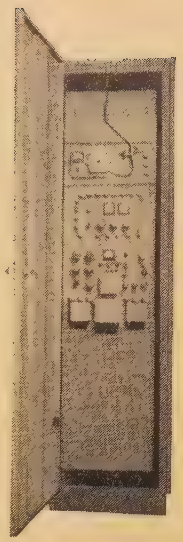
If there is some doubt as to the quality of the short that is being used, the exact attenuation involved in this unit alone can be determined by placing it directly on the end of the slotted line. This value can then be subtracted from the value determined with the test section in place. The shorting plugs that are commercially available generally do not have much more than 0.1 db loss, which can often be neglected unless precision work is being performed.

(*Continued on page* 21)

Table 1. Attenuation loss in db for various standing-wave ratios.

VSWR	db	VSWR	db	VSWR	db	VSWR	db	VSWR	db	VSWR	db
1.001	33.01	1.085	13.89	1.31	8.72	1.56	6.60	1.81	5.40	2.5	3.68
1.002	30.01	1.090	13.65	1.32	8.60	1.57	6.54	1.82	5.36	2.6	3.52
1.003	28.25	1.095	13.43	1.33	8.49	1.58	6.48	1.83	5.325	2.7	3.375
1.004	27.00	1.10	13.22	1.34	8.37	1.59	6.42	1.84	5.285	2.8	3.24
1.005	26.03			1.35	8.27	1.60	6.36	1.85	5.255	2.9	3.125
1.006	25.24	1.11	12.83	1.36	8.17	1.61	6.315	1.86	5.22	3.0	3.01
1.007	24.58	1.12	12.47	1.37	8.07	1.62	6.26	1.87	5.18	3.1	2.90
1.008	24.00	1.13	12.14	1.38	7.97	1.63	6.20	1.88	5.145	3.2	2.805
1.009	23.48	1.14	11.84	1.39	7.87	1.64	6.16	1.89	5.12	3.3	2.715
1.010	23.03	1.15	11.56	1.40	7.78	1.65	6.105	1.90	5.085	3.4	2.635
		1.16	11.30	1.41	7.68	1.66	6.055	1.91	5.05	3.5	2.55
1.015	21.27	1.17	11.06	1.42	7.60	1.67	6.005	1.92	5.015	3.6	2.48
1.020	20.02	1.18	10.83	1.43	7.52	1.68	5.95	1.93	4.98	3.7	2.40
1.025	19.08	1.19	10.62	1.44	7.44	1.69	5.905	1.94	4.955	3.8	2.34
1.030	18.30	1.20	10.41	1.45	7.35	1.70	5.86	1.95	4.92	3.9	2.28
1.035	17.64	1.21	10.21	1.46	7.28	1.71	5.82	1.96	4.89	4.0	2.215
1.040	17.07	1.22	10.04	1.47	7.21	1.72	5.775	1.97	4.855		
1.045	16.56	1.23	9.86	1.48	7.13	1.73	5.725	1.98	4.825	5.0	1.76
1.050	16.13	1.24	9.70	1.49	7.06	1.74	5.68	1.99	4.80	6.0	1.46
1.055	15.73	1.25	9.54	1.50	6.99	1.75	5.64	2.00	4.77	7.0	1.25
1.060	15.36	1.26	9.39	1.51	6.92	1.76	5.60			8.0	1.09
1.065	15.02	1.27	9.24	1.52	6.86	1.77	5.56	2.1	4.50	9.0	0.965
1.070	14.70	1.28	9.10	1.53	6.80	1.78	5.52	2.2	4.255	10.0	0.87
1.075	14.42	1.29	8.97	1.54	6.72	1.79	5.475	2.3	4.045	15.0	0.58
1.080	14.15	1.30	8.84	1.55	6.66	1.80	5.44	2.4	3.855	20.0	0.43

RAYTHEON MICROWAVE EQUIPMENT



RAYTHEON

2000 MC
AUDIO-VIDEO

Magnalink

MTR-50

Specifically designed for multi-hop intercity television program relaying, studio-transmitter link or long distance remote pick-up service. A high power CW magnetron provides 7 to 10 times more power for extended range and maximum fade protection. Audio channel subcarrier equipment available for simultaneous audio relaying.

SYSTEM
Range up to 100 miles
Carrier Frequency: 1990-2110 mc
Video Frequency Response: ±2 db to 6 mc

TRANSMITTER
Type: QK-174C FM Magnetron
RF Power Output (to antenna cable): 50 watts
Frequency Deviation: ±2.5 mc
RF Output Impedance: 51.5 ohms
Center Frequency Stability: .05 percent
Video Input (peak to peak) .3 volt minimum, 1 v nominal
Video Input Impedance: 75 ohms nominal. Adjustable from 50 to 110 ohms
Primary Power Requirements: 117 volts ±5 percent, 50-60 cycles, 1100 watts
Panel Space: (Standard 19″ rack) 49″
Weight (crated less antenna) 475 lbs.

RECEIVER
Type: Single Superheterodyne
RF Input Impedance 51.5 ohms
RF Signal Input (minimum) 73 micro-micro watts
Local Oscillator: Type 2K-28 reflex klystron
IF center frequency: 130 mc
IF Bandwidth 17 mc
Video Output (2 channels): 2 volts peak to peak (adj.)
Video Output Impedance: 75 ohms
Primary Power Requirements: 117 volts ±5 percent, 50-60 cycles, 400 watts

ANTENNA DATA

Reflector Dia.	Gain (DB)	Beamwidth (3DB)
4′	26	8.75°
6′	29.4	5.8°
8′	31.5	4.4°
10′	33.9	3.5°

RAYTHEON

7000 MC
AUDIO-VIDEO

Microlink

KTR-100

Provides in unbelievably light and compact form complete equipment for multiplex wide band video and high quality audio transmission and reception. Highly portable yet ideally adapted for permanent installation with installation, control and servicing features never before available.

Range up to 25 miles
Carrier Frequency Range 6875–7125
IF Frequency 130 mc
Transmitter Power Output 0.1 W min.

ANTENNA DATA

Reflector Dia.	Gain (DB)	Beamwidth (3DB)
2′	28	5.0°
4′	34	2.5°
6′	38	1.7°

MAXIMUM FREQUENCY DEVIATION
7.6 mc peak to peak video plus 2.4 mc peak to peak subcarrier or 10 mc peak to peak video only

VIDEO CHANNEL
Overall frequency response 6 cycles to 6 mc ±2 db
Video input impedance 40–170 ohms
Video input level for 10 mc peak to peak deviation is .4V peak to peak input
Video output impedance 75 ohms (2 independently controlled outputs)
Video output level ½ to 2.5 V peak to peak for both outputs with video gain control

TRANSMITTER RF MONITOR
Frequency response 6 cycles to 1 mc
Level: .5 V p to p for 12 mc deviation
Polarity: Normally black negative
Impedance: 50 ohms
Outputs: One output at RF head, one output at Transmitter control

AUDIO CHANNEL
Overall Frequency response 20 cycles to 8000 cycles ±1 db
Input impedance 500/600, 333, 200/500, 125, 50 ohms balanced or unbalanced
Input level — 10 dbm
Output impedance 500/600 balanced or unbalanced
Output level maximum +10 dbm
Distortion 1.5 percent (approx.)
Signal to total noise 50 db below swing ±50 kc

POWER SUPPLY
95–140 V 50–60 cycles single phase
Transmitter 190 W continuous plus 130 W intermittent
Receiver 180 W continuous plus 100 W intermittent
One special voltage stabilizer transformer required for frequency other than 60 cycles.

PHYSICAL DIMENSIONS
RF head — Receiver and Transmitter 14″ x 23″ x 11″
Weight: approx. 38 lbs.
Control unit — Receiver and Transmitter 21″ x 16″ x 9″
Weight: approx. 43 lbs.
Tripod weight 24 lbs.
Tilt head 30 lbs.
4′ dish 22 lbs.
RF Feed 3 lbs.
Reflector Bracket Assembly 11 lbs.
Hi Hat 2½ lbs.

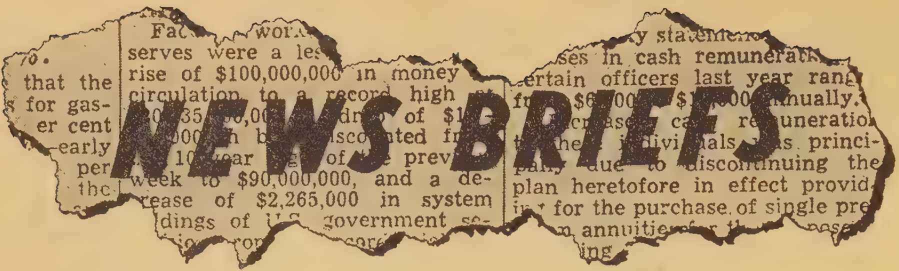
Circuit design and packaging by specialists

Write for Complete Information

RAYTHEON
MANUFACTURING COMPANY
Equipment Sales Division
Dept. 6270 RE, Waltham 54, Massachusetts

EXCELLENCE IN ELECTRONICS

Light and convenient units with standardized connections



NEWS BRIEFS

TELEVISING MICROSCOPE

Scientists and others who tire of squinting with one eye into the tiny eyepiece of a microscope should be interested in this new British instrument which throws a clear, highly magnified image onto a television screen. Called the "Cintel" Flying-Spot microscope, it was developed by Professor J. Z. Young, of University College, London.

PRINTED CIRCUITS

At a meeting of the ASME in April, Mr. Norman A. Skow, director of research and development of the *Synthane Corporation*, Oaks, Pa., discussed the advantages of printed circuits, the materials used in their fabrication, and methods of assembly. Serving as a conducting medium in electronic assemblies, such circuits replace to a large extent the internal maze of wires normally found in conventionally assembled equipment.

Practical because of their simplicity and uniformity, printed circuits are particularly adaptable to complex commutators and switching networks where subminiaturization is required. Elimination of manual wiring speeds assembly, Mr. Skow pointed out, and as mechanical reproduction reduces the probability of error, inspection time is automatically shortened while assemblies become more uniform and reliable.

HEATER REGULATIONS

After June 30, the operation of any industrial heating equipment which does not comply with all of the requirements of Part 18 of the Federal Communications Commission's Rules and Regulations Governing the Industrial, Scientific and Medical Services will constitute a violation of law. Part 18 may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for five cents a copy.

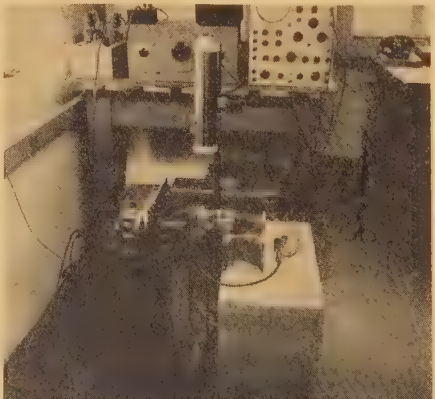
Among other things, the requirements specify that industrial heating equipment must be operated with sufficient shielding and filtering to prevent interference to authorized radio communication services, and that radiation outside of the I.S.M. bands from such heaters shall not exceed 10 microvolts per meter at a distance of one mile or more from the equipment.

IRE APPOINTMENT

The Institute of Radio Engineers named Dr. William L. Everitt to serve on the committee of scientists formed at the request of Secretary of Commerce Sinclair Weeks to evaluate the present functions and operations of the National Bureau of Standards in relation to the present national needs. Dr. Everitt, a renowned radio authority and dean of the College of Engineering at the University of Illinois, is a fellow, director and former president of the IRE.

VIBRATION CALIBRATOR

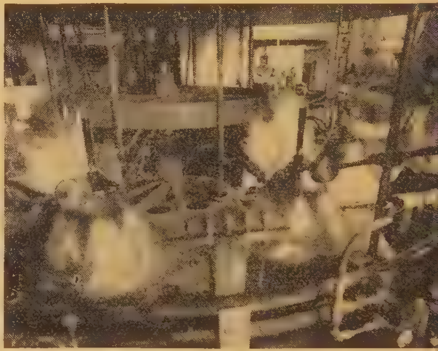
A resonance-type vibration calibrator has been constructed at the National Bureau of Standards which combines unusual simplicity and economy of construction with pure waveform and high sensitivity. The calibrator consists essentially of a system of mechanically resonant beams (two parallel metal plates separated by a combination clamping block and calibration table) excited by an ordinary 8" loudspeaker; the transducer being calibrated is fastened rigidly to the mechanical system, and the amplitude of vibration is observed optically with reference to a fixed point in space.



This device has been used to calibrate moving-coil type velocity gages over a frequency range of 10-250 cps, at displacement amplitudes of as little as 50 microinches. It can calibrate sensitive transducers at low levels of acceleration, of the order of 0.05 to 5 gravities.

ELECTRONIC TUBE PLANTS

Production of electronic tubes is well under way in the two new manufacturing plants of the newly formed *Westinghouse Electronic Tube Division*. Large cathode-ray television picture tubes and many types of power tubes are now being manufactured at the Elmira, N. Y., plant, headquarters for the division, while small receiving tubes are being produced at the Bath, N. Y. plant.



Shown in the photograph is one stage in the production of metal-cone cathode-ray tubes at Elmira. As each tube rotates from position to position in the large rotary sealing machine, the metal and glass parts are preheated, joined and annealed.

PERKIN MOVES

The *Perkin Engineering Corporation* has moved into a 10,000 square foot plant at 345 Kansas Street, El Segundo, Calif. The new plant is fully equipped with modern machinery and facilities for the company's production of standard and military lines of laboratory and airborne d.c. power supplies and associated electronic equipment.

LOW-LEVEL SOUNDING SYSTEM

Atmospheric temperature and humidity gradients can be measured with increased accuracy, at heights up to 2000 feet, by means of a low-level sounding system developed by the National Bureau of Standards for the Navy Bureau of Ships.

The NBS system is an improved form of "wiredsonde"; airborne instruments are carried aloft by a balloon or kite and are connected to a lightweight 3-conductor electrical cable that is

eeled out from the ground. The airorne unit consists of a gravity motor left), an electromechanical altimeter center, removed from housing), and he elements for sensing humidity and emperature (right, on rectangular nounting).

A detailed description of the system nay be found in "National Bureau of Standards Mobile Low-Level Sounding System," which appeared in the NBS Journal of Research, January, 1953 (RP 2381).

MOLDITE EXPANDS

Through the acquisition of *Ferricore, nc.*, of Yonkers, N. Y., the *National Moldite Company* has added ferrite cores to its regular line of magnetic iron cores and molded coil forms. The purchase was made by the *National Moldite Company*, which is located at Hillside, N. J., as part of an expansion program to round out the *Moldite* line of precision electronic components.

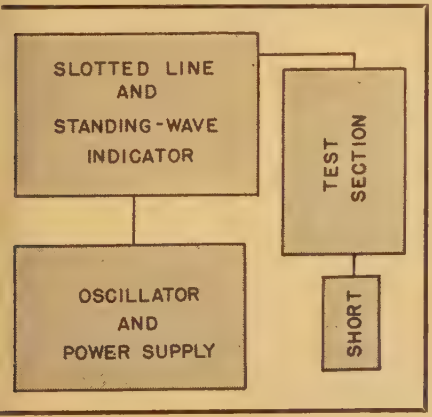
Measuring Attenuation

(*Continued from page* 18)

The accuracy of this method of measuring attenuation does not depend upon the stability or calibration of a power meter. In addition, the method provides a means of determining the loss in a system for which it might be extremely difficult or inconvenient to use either the power differential or the substitution method.

One example of the latter advantage is in the determination of the attenuation of an antenna feeder system where the output and input are separated by more than 100 feet of plumbing. Obviously, the conventional methods would prove to be extremely awkward in such a case. With the slotted-line method, all that is required is to short the receiving end of the system, determine the VSWR from the sending end, and look on the chart for the required loss. The results may be easily, quickly and accurately determined in this manner.

ig. 1. Block diagram of the test setup for measuring attenuation. The loss may be determined from Table 1 after the standing-wave ratio of the test section with far end shorted has been measured at the desired frequency.


SLOTTED LINE AND STANDING-WAVE INDICATOR
TEST SECTION
OSCILLATOR AND POWER SUPPLY
SHORT

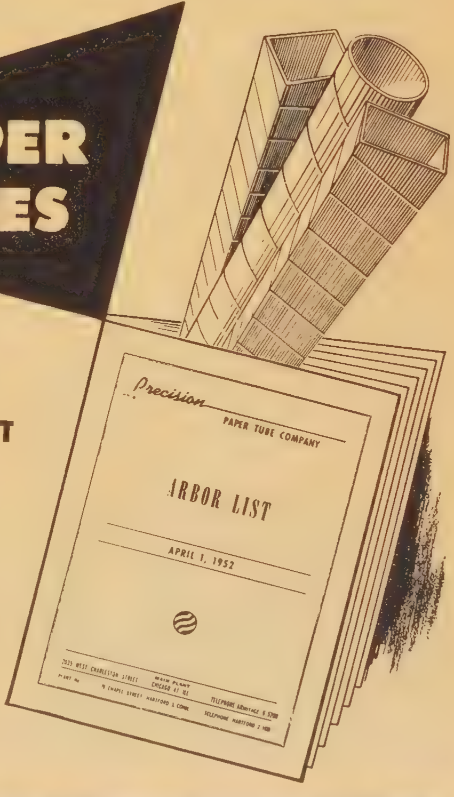
Phase Angle Measurements

(*Continued from page* 13)

respect to the input voltage may occur. The variable phase shifter produces a leading phase angle at all settings. Hence, if the phase pattern approaches and goes through zero without reversing slope as the *RC* product is varied, the unknown angle represents a phase lag. If, however, a decrease in *RC* product produces an apparent increase in phase angle, accompanied by an abrupt reversal in pattern slope, it is an indication that the over-all phase has gone through 180° in the leading direction. In this case, the unknown phase angle is calculated by subtracting the result as obtained from Eqt. 3 from 180°. A small leading unknown phase angle will, under these conditions, require a correspondingly small *RC* product (large introduced phase angle) for a null pattern of opposite slope, and the reversal in slope will occur somewhere within the range of the *RC* network variables. In the majority of instances, the direction of an unknown phase shift will be apparent from inspection of the characteristics of the device under test or from data already taken.

Operationally, this technique of phase measurement may not be entirely suitable for production applications or the like, since a calculation is required for each frequency, and compensation of the indicating instrument is generally necessary. Such refinements as the substitution of a phase discriminator and differential amplifier for the oscilloscope, and direct calibration of the *R* and *C* elements with appropriate phase angle and frequency scales, would facilitate operation at the expense of added complexity. It is felt, however, that for occasional measurements of this type, the method as outlined combines extreme simplicity with excellent stability and accuracy.

* * *



PRECISION PAPER TUBES

any shape . . . length . . .
ID or OD . . . to meet
your specific requirements

SEND FOR ARBOR LIST

Free to you upon request . . . lists over 1500 sizes . . . all promptly available. A free sample is also yours for the asking . . . just send your specifications.
Precision Paper Tubes are spiral-wound of finest dielectric kraft or fish paper, phenol impregnated, cellulose acetate or combinations.

Write US TODAY!

PRECISION
PRECISION PAPER TUBE CO.
2063 W. Charleston St., Chicago 47, Ill. Plant No. 2: 79 Chapel St. Hartford, Conn.
Also Mfrs. of Precision Bobbins

NEW PRODUCTS

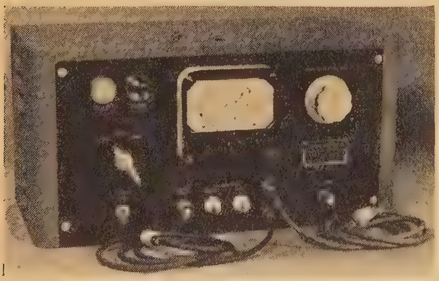
DECIMAL SCALER

The *Berkeley Scientific Division* of *Beckman Instruments, Inc.*, 2200 Wright Avenue, Richmond, Calif., has announced the Model 2105 decimal scaler for use in radioactivity measurement. A wide selection of preset counts is provided for convenient automatic operation, and there is a wide selection of scaling factors for the operation of an external register, a printing device, or a counting rate computer. New design features in the r.f. high voltage supply lead to increased reliability and improved regulation.

Model 2105 is a direct-reading instrument which utilizes two plug-in decimal counting units and a four-digit mechanical register. High voltage is variable from 300 to 2500 volts, and standard ¼-volt input sensitivity is provided.

LEAKAGE TESTER

Whether components or complete assemblies will exhibit satisfactory leakage performance at voltages at or in excess of normal operating potential can be determined with the *Cinetech* high-potential leakage tester. It is being made available to the industrial field by *Cinetech Company, Inc.*, 106 West End Ave., New York 23, N. Y.

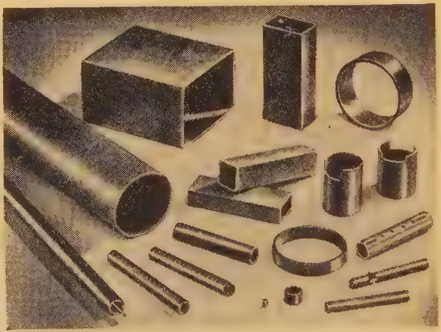


This device will indicate satisfactory performance when connected to an equivalent resistance of 100,000 to 110,000 ohms at one of three available voltage ranges, namely, 300, 1000 and 1500 volts, a.c. It will reject instantly, without destructive effects to the equipment under test, when the equivalent resistance of the tested material is less than 100,000 ohms with high voltage applied.

RESINITE TUBING

Resinite tubing, developed by the *Precision Paper Tube Company*, is said to provide greatly increased wall strength, improved dielectric and other electrical properties, and high chemical and moisture resistance. Tubes are available in all shapes, widths and lengths. Inner diameters range from .125″ to 3″, with wall thicknesses from .006″ to .100″.

These tubes can be supplied threaded inside or outside, slotted, punched, or embossed. Threaded coil forms incorporate a special three-row design to afford axial pressure in excess of 25 lb. Torque can be controlled to ± 1 inch-ounce.



For further information, write to *Precision Paper Tube Co.*, Dept. H., 2035 W. Charleston Street, Chicago 47, Ill.

SENSITIVE INVERTER

In combination with a suitable 60-cps voltage-sensitive device, the *Ballantine* sensitive inverter Model 700 makes possible: (1) accurate measurement of d.c. potentials as low as 10 microvolts, and (2) detection of d.c. potentials as low as 1 microvolt, while presenting to the source a resistance of not less than 10 megohms.

Announced by *Ballantine Laboratories, Inc.*, Boonton, N. J., this unit inverts d.c. potentials to a.c. voltages directly proportional in magnitude to the d.c. input voltages and phase-sensitive to the d.c. polarity. It features a built-in calibrator which minimizes the errors caused by a companion instrument or by the departure of line frequency and voltage from nominal values.

ANALOG COMPUTER

The Research & Control Instruments Division of *North American Philips Company, Inc.*, 750 South Fulton Ave., Mount Vernon, N. Y., has announced a computer for recording random counting rates on a linear chart with a constant computed statistical accuracy.

This instrument makes use of Ohm's law ($IR = E$) as the analog to the basic counting equation ($nT = N$; $n =$ counting rate, $T =$ time interval, $N =$ total number of counts). A slidewire resistor is driven by a synchronous motor so that resistance (R) in the circuit is proportional to time (T). With fixed battery voltage (E), the current recorded is proportional to n.

The *Norelco* computer must be used with a scaling circuit adjusted for fixed count operation. The range of the instrument is controlled by the choice of scale factor ($N = \text{scale factor} \times 100$) and the speed with which the slidewire is driven.

CHAIN AMPLIFIER

Designed specifically for television distribution system requirements, the *SKL* Model 212A-TV chain amplifier has a bandwidth of 40 to 225 mc.; up to 12 v.h.f. television channels can be amplified simultaneously with high fidelity. The unit has a gain of 21 db, and a new manual gain control is provided—with a range of 5.5 db—to permit the adjustment of signal levels in the system.

Use of a parallel tube circuit gives the Model 212A-TV chain amplifier high operating reliability. Tube failure results in a loss of 1.6 db gain, not in a loss of the entire picture. Untuned circuit design eliminates loss of picture resolution due to inadequate bandwidth and frequency drift.

For further information, write to *Spencer-Kennedy Laboratories, Inc.*, 186 Massachusetts Ave., Cambridge 39, Mass.

PRECISION "MAGIC TEE"

The availability of a new precision X-band hybrid junction has been announced by the *General Precision Laboratory*, 63 Bedford Road, Pleasantville, N. Y. Using a new type of construction, the unit assures isolation of -50 db or better as well as low VSWR over a broad frequency range. In addition to its function as a "magic tee," it can be employed as a highly accurate power divider in the configuration of a shunt or series tee by blocking the appropriate arms.

This component is of precision-machined rather than brazed wave guide fabrication, permitting the holding of close mechanical tolerances with improved performance factors.

SCALING UNIT

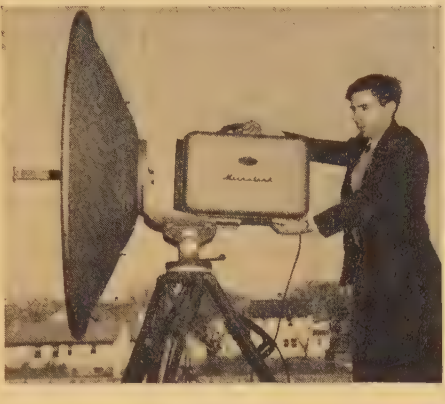
To speed counting procedures in radioisotope laboratories, the *Nuclear Instrument & Chemical Corporation*, 229 West Erie Street, Chicago 10, Ill., has developed a scaling unit which features an electrically reset timer and register. It is available with either a 500-5000 volt or 500-2500 volt variable power supply.

Slope-mounted in its cabinet, the Model 182 is designed for precision counting with new simplified controls. It has a wide sensitivity range and linear amplification from 1 millivolt to 1 volt. Resolution time is 2 microseconds, and the amplifier circuit has a rise time of less than 0.2 microsecond.

MICROWAVE TV LINKS

Two television microwave links have been announced by the *Raytheon Manufacturing Company*, Waltham 54, Mass. Respectively the most portable and the most powerful TV microwave equipment, they are the first such devices to handle pictures and sound simultaneously on the same wave band.

The KTR-100 "Microlink" is a compact, lightweight relay which operates in the frequency range of 6875 to 7125 mc., with a power output of 0.1 watt. It includes a completely new a.f.c. and limiter, a special cable compensating switch, accurately controlled transmitter frequency, built-in voltage regulator, and provisions for frequency and modulation monitoring. The transmitting unit is shown in the photograph.



The MTR-50 "Magnalink" is a much larger link, capable of transmitting wideband intelligence over distances of 100 miles. It operates in the 2000-mc. frequency range and is powered by a 50-watt magnetron. By virtue of normal gain factors through a 10-ft. parabola, the 50-watt tube output is multiplied, resulting in an ERP of 50,000 watts.

BALUN

Accurate measurements of balanced impedances in the 50-1000 mc. frequency range can be made with the help of the Type 874-UB balun. Announced by the *General Radio Company*, 275 Massachusetts Avenue, Cambridge 39, Mass., the balun is a tunable semi-artificial half-wave line. It acts as a transformer and makes it possible to connect a balanced impedance to an unbalanced coaxial system, such as is used on high frequency measuring instruments. The balun has two advantages over a conventional transformer for this purpose —it can be tuned over a wide frequency range and has very low losses.

ELECTRONIC RESISTANCE ANALYZER

Precision measurements of resistors may be made with the electronic resistance analyzer now being produced by *The Kuljian Corporation.* It can be used by resistor manufacturers in selecting resistors to within specified limits. Having high accuracy and a wide range, it is particularly adapted to the selection and measurement of resistances used in analog computers.

Available in either a rack or bench model, this instrument is designed for 115-volt a.c. operation. A precision of balance of 0.02% can be realized over almost the entire range. Range and accuracy tolerances, as well as addi-

(*Continued on page* 28)

TECHNICAL BOOKS

"ELEMENTS OF THE THEORY OF FUNCTIONS" by Konrad Knopp. Translated by Frederick Bagemihl. Published by *Dover Publications, Inc.*, 1780 Broadway, New York 19, N. Y. 140 pages. Paper Edition, $1.25; Cloth Edition, $2.25.

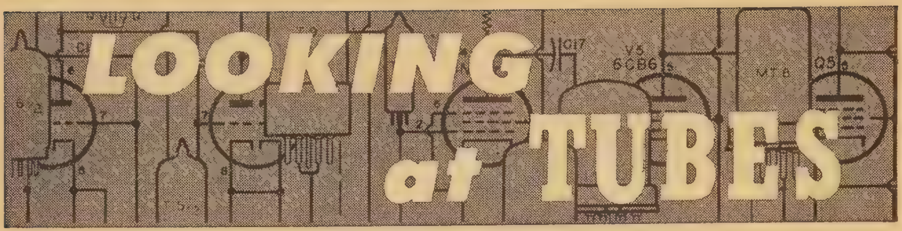
In the "Elements of the Theory of Functions," only those topics are treated which are simplest yet most important for the further development of the theory. The foundations of real analysis and the elements of analytic geometry, knowledge of which is necessary for a proper understanding of the book, are covered in Chapter 1.

After an introduction to the system of complex numbers and operations performed on them, the concept of sets of numbers, the limit concept, and closely related matters—in particular, the theory of infinite series—are extended to complex quantities. Then, the notion of function and its most important properties is carried over to the case in which independent and dependent variables are complex; when combined with the limit concept, this yields the foundations of a differential calculus for functions of a complex variable. Finally, the elementary functions are dealt with in greater detail.

"THE THEORY OF ELECTRONS and Its Applications to the Phenomena of Light and Radiant Heat" by H. A. Lorentz. Second Edition. Published by *Dover Publications, Inc.*, 1780 Broadway, New York 19, N. Y. 343 pages. Paper Edition, $1.70; Cloth, $3.50.

This book is composed largely of a series of lectures which was delivered at Columbia University in 1906 on the theory of electrons and its more important applications in the domain of light and radiant heat. For many years the original edition has been out of print and almost impossible to obtain. In the new edition, the text has been left nearly unchanged except for a small number of alterations and additions in the footnotes and the appendix.

Emphasis is on the general ideas and hypotheses of a physical nature involved, with such mathematical calculations as are used being given in the hundred-odd page appendix. The following topics are covered in detail: general principles applying to the theory of free electrons; emission and absorption of heat; theory of the Zeeman-effect; propagation of light in a body composed of molecules—and the inverse Zeeman-effect; and optical phenomena in moving bodies.



LOOKING at TUBES

By **WILFRID B. WHALLEY**

Adjunct Professor of Electrical Engineering
Brooklyn Polytechnic Institute

Reproducing tubes for monochrome television.

THE VAST growth of television, for entertainment and industrial purposes, has required the design and manufacture of millions of picture-reproducing tubes. All picture tubes—or *kinescopes*, as they are often called—represent one large section of the general group known as cathode-ray tubes.

Cathode-Ray Tube Development

"Cathode ray" was the name given at the end of the last century to the phenomenon which occurred when a heated metallic or semiconductor surface was placed in a high voltage positive electric field, and light was produced from a glass surface at the positive potential.

First use of this phenomenon was made at the beginning of the century when a small filament was sealed in the small end of a chemical flask, the gas pressure reduced to a moderate vacuum, and a high positive voltage applied to the large end. Electrons emitted by the filament were accelerated toward the large end or face, and produced an illuminated spot due to bombardment of the crystal structure of the glass. It was found that the diameter of the spot depended upon the gas pressure, a suitable pressure producing a minimum-size or "best focused" spot. These earliest devices made use of "gas focusing" of the electrons, and produced a beam of moderate diameter.

Next, it was found that the presence of an electric or magnetic field perpendicular to the axis of the tube would move the spot over the face. For the electric field, the movement was toward the positive potential, similar to the acceleration of electrons toward a positive terminal. In a magnetic field, the spot was found to move at right angles to the field, in the same way that a conductor carrying electricity will move in a magnetic field.

By applying a.c. voltages between pairs of electrodes or "plates" in or near the neck of the tube, it was possible to produce patterns corresponding to the waveform of the a.c. voltage. From these experiments have come the cathode-ray tubes used for oscilloscopes and for television kinescopes.

Picture Tubes

Since the first experimental devices were developed, major improvements have been made in focusing the electrons, providing good vacua, using suitable coatings on the glass for higher light output, and reducing the adverse effects of ion bombardment. Present focusing is by means of suitable structures known as electron guns, where the focusing is always dependent—in whole or in part—upon electric fields; a magnetic lens may also be employed. As electrons move above a certain critical velocity through a gas, any collision with an atom or a molecule can produce gas ions. The negatively ionized particles will move toward the screen and the positively charged particles toward the cathode, since the cathode (or the control grid) is the most negative point in the tube. The ion bombardment decreases the light output of the screen by affecting the crystal structure. It also damages the cathode, in severe cases removing the coating and making a hole in the surface of the cathode. Hence, much emphasis has been placed upon removing as many of the gas molecules as possible.

As even the best vacuum pumps, in high speed production, leave sufficient gas to produce ion spots on the phosphor, either an ion trap is used with the gun, or an aluminum film is placed over the surface of the phosphor.

Ion Traps

The ion trap uses the principle of separation of particles of different masses—the same principle that is used in the mass spectrometer. When a charged particle is accelerated in an electric field, and passes through a magnetic field, it moves in a circular path. The radius of curvature depends upon three quantities: the mass, the velocity (due to the electric field), and the strength of the magnetic field. Since electrons have an effective mass very much below that of gas atoms and molecules, a suitably shaped electron gun placed in a magnetic field of the correct strength will remove the ions from the electron stream.

Aluminum Film

It has been found that thin films of certain metals will pass electrons, but will absorb ions. The most useful metal for this purpose is aluminum. Since aluminum is a low-cost metal which can be evaporated in a vacuum at a moderate temperature, it is increasingly used in coating the back or inner surface of the fluorescent screen. Many tubes operate without ion "burn" with a straight electron gun, due to the protection by the aluminum film. Of course, the aluminum film provides other advantages: increased light output is obtained since light is reflected forward which would otherwise be directed back into the tube and be lost inside the envelope; and the fluorescent screen is maintained at the applied potential. The aluminum film also increases the small area contrast of the picture.

Present Kinescopes

Present-day tubes can be divided into two groups—those which are electrically focused, and those which use magnetic focus. Both types have certain advantages. With electrostatic focus guns of the correct aperture and cylinder design, good focus is obtained without an extra magnetic field. Also, the tube will stay in focus with changes in high voltage, such as those due to a.c. line voltage changes.

The magnetically focused tubes will maintain good spot size at the center of the picture for higher beam currents and correspondingly higher peak brightness, due to the more stable and generally larger magnetic-type lens.

"Sticking" Potential

All fluorescent screens in nonaluminized tubes tend to operate at a potential where the secondary electron emission is unity. This is due to the low conductivity of typical phosphors and the correspondingly high resistance to the positive voltage source. As the electrons in the beam penetrate the crystal structure, secondary electrons are released; if the secondary emission ratio were more than unity, the potential of the phosphor would tend to shift to an equilibrium point for the correct one-to-one ratio.

As the phosphor becomes older, the potential tends to shift downwards, reducing the light output from the tube. With an aluminum film in contact with the phosphor, the crystals are held at the applied high voltage, giving a light output corresponding to the electron velocity.

irect-Coupled Amplifier

Continued from page 5)

on only, with a coupling capacitor at
ie output, regulation may not be nec-
ssary at all. In multichannel work,
course, the power supplies must be
gulated, if only to minimize cross-
iannel interference.

If stability against line voltage
ianges is required in the heater sup-
y, the 6X8 may be run from a 12-volt
ansformer in series with an *Amperite*
pe 5T4 current regulator (not to be
nfused with the rectifier of the same
signation). In view of the generation
odd harmonics by the nonlinear bal-
st tube, it is wise—if use of the 5T4
desired—to connect the potentiom-
er for hum balancing on the 6X8 side
the 5T4, as shown in Fig. 2, using a
mpletely isolated winding for the 12
lts. In this way, the grounded center
m will move between the two termi-
als of the heaters themselves, and a
alance adjustment for the harmonics
well as for the 60-cps fundamental
ill occur.

By use of the above techniques, the
im may be made as low as 2 mv. at
ie output (10 microvolts referred to
ie input), which is just about twice
ie noise figure. With film resistors in
ace of the carbon ones now used, it
ight be possible to reduce the noise.
owever, an amplifier of this band-
idth and input resistance is liable to
ave somewhat more noise than a per-
n who habitually deals with audio
nplifiers or similar equipment might
pect.

After the amplifier was adjusted for
st response to a 10-kc. square wave,
s response was noted to be down 1 db
240 kc. and 3 db at 520 kc., there
ing a rise of about 0.2 db in the vi-
nity of 400 kc. The 10-kc. square
ave, after passing through the ampli-
r, has about 5% overshoot and a rise
ne of a little under a microsecond.

Maximum output was over ± 10 volts
c., and the equivalent at a.c., up to
least 200 kc. In order to get a larger
ing than this, especially at the
gher frequencies, it would have been
cessary to raise the power consump-
n substantially, which was not allow-
le. This is, after all, a fairly low-
vel device, being intended to amplify
signal of perhaps 50 mv. up to the
-volt level (full scale).

A.C. applications of this circuit are
entiful. With or without an input
ansformer, it would serve as an ex-
llent audio amplifier, although as it
ands its main use would be in medium
vel work. If it were to be used as a
eamplifier, the 6X8 could be removed
d two 5879's substituted since drift
uld no longer be a factor. The input
sistor could be reduced to perhaps
0*K*, leaving the 20*M* the same and removing the 22*K* and 1 *K* divider, with the 20*M* resistor hung directly between output cathode and input grid. The low-hum, low-microphonic features of the 5879's would prove beneficial while the gain of the pentode would be retained (although the 5879 has only about half the gain of the "hotter" pentodes, gain being sacrificed for wide spacing and reliability, rigidity, etc). This change should be possible without affecting parts values very much; although the cathode resistor will be different, changing the "Zero" pot will suffice. An amplifier using 5879's in this way was the ancestor of this design, and has worked well for over a year as an experimental oscillograph galvanometer driver.

For any application involving accurate measurement of a d.c. signal, however, the drift of this amplifier would be excessive. Some stabilizer would be necessary, such as the *RCA* drift compensator which is used in almost all modern d.c. amplifiers of good quality. For less critical applications, as in the oscilloscope described, and for all a.c. applications where the d.c. type of amplifier is used merely to avoid trouble in stabilizing the amplifier under feedback, such a stabilizer would not be needed.

In the amplification of a.c. signals, a d.c. amplifier has considerable merit: there is no problem of stabilizing the amplifier against "motorboating" at the low end, when feedback is used; and after one has put coupling capacitors at the input and output, the low-frequency response is solely determined by the input and output time constants, which may in nearly all cases be accurately known and allowed for and which are usually very stable. Transient performance at the low end is far superior to that of the conventional multistage a.c. feedback amplifier.

Other uses of this circuit might be found in vacuum-tube voltmeters. It could be made into a combination a.c. and d.c. meter (provided that rectification was added) if the drift were acceptable, since it has a fairly good bandwidth .and response down to d.c. It might prove useful as an integrating amplifier; its simplicity allows networks to be connected from input to output without much instability, while its gain of 20,000 before feedback is good enough for many purposes. As the nucleus for a carrier amplifier, either for a relatively high (5-10 kc.) carrier frequency or for larger amounts of feedback at a lower carrier frequency, it would seen to offer some possibilities also.

BIBLIOGRAPHY:

Goldberg, E. A., "Stabilization of Wide Band D. C. Amplifiers," RCA Review, June, 1950.

◆

WHEN YOU ORDER
WELLS
COMPONENTS...

HERE'S WHAT
YOU GET

1. IMMEDIATE DELIVERY FROM STOCK (in any quantity)
2. FINEST QUALITY OF FAMOUS BRANDS
3. GENERALLY LOWER PRICES
4. RETURN PRIVILEGE FOR FULL CREDIT IF NOT SUITED TO YOUR REQUIREMENTS

The valuable service Wells provides to the industry is being used by many of our greatest manufacturers as a matter of course.

Our vast stock (the world's largest) may contain just the components you need to fill urgent orders — at a substantial savings in time and cost.

ADEL CLAMPS • ANTENNAS, Insulators, Mast Sections • BINDING POSTS • BLOWERS • CABLE ASSEMBLIES • CHOKES • COILS • CONDENSERS Oil Filled, Bathtub, Hearing Aid, Transmitting Micas, Silver Micas, Ceramic, Variable, Trimmer • CRYSTALS • FILTERS • FUSES & MOUNTINGS • GENERATORS • GROUND RODS • HEADSETS • I.F. COILS • JACKS • JACK BOXES • KEYS, Telegraph KNOBS • LAMPS • LORD MOUNTS • LUGS MOTORS & BRUSHES • PLUGS • RECTIFIERS Selenium, Copper Oxide, Meter, Diode • RESISTORS—All Types • SELSYNS • SOCKETS • SWITCHES Aircraft, Micro, Switchettes, Toggle • TIMERS • TUBING—Flexible • TUNING SHAFTS • TRANSFORMERS All Types • VIBRATORS • WALKIE TALKIES

DYNAMOTORS

OVER 100,000
NEW DYNAMOTORS
IN STOCK!

DM 32A — DM 53A — PE 86 — PE 101C
DM 33A — D 101 — PE 94, etc.
Large quantities of brushes for all types of dynamotors and motors.

Write us for quotations. Advise us your requirements.

A complete Signal Corps stock number listing of items in our stock. Write for listing No. SG-200. (For government agencies and contractors only.)

Manufacturers and distributors—write for new Condenser Catalog C-10 now available.

Write, Wire, Phone Your Requirements
all phones: SEeley 8-4143

WELLS
SALES, INC.

833 W. Chicago Ave., Dept. R, Chicago 22, Illinois

NEW LITERATURE

TUBE CHARACTERISTIC CURVES

Here is a conductance curve design book which provides both static and dynamic data on the operating characteristics of 17 popular receiving tubes. Inclusion of dynamic data in addition to static permits the direct determination of both small and large signal operating characteristics of a circuit being designed.

Brief application notes and the basic equations for the most commonly used circuits are included in this book, which is available for $1 per copy from *Kann-Ellert Electronics, Inc.*, 9 S. Howard Street, Baltimore 1, Md.

ELECTRICAL INSULATION MATERIAL

Helpful information on the features and uses of fibre and plastic for electrical insulation is incorporated in two catalogs which may be obtained by writing to the Publications Department, *Insulation Manufacturers Corporation*, 565 West Washington Boulevard, Chicago 6, Ill.

Imcor reinforced plastics are described in an 8-page catalog while Phenolite laminated plastics, National vulcanized fibre, and Peerless fishpaper products are covered in a 32-page catalog. Both contain complete descriptions, tabular data, and other information on grades, properties, and fabricating techniques for sheets, rods, tubes, and fabricated or molded parts.

DICTIONARY OF CARRIER TERMS

Definitions of 150 terms commonly found in telephone and telegraph carrier equipment literature are given in the new *Lenkurt* Bulletin EB-101, entitled "A Dictionary of Carrier Terms." The 16-page booklet also includes a general discussion of carrier equipment theory.

Copies of this publication are available from *Lenkurt Electric Co.*, 1115 County Road, San Carlos, Calif.

HERMETICALLY SEALED RELAYS

General-purpose hermetically sealed relays for electronic applications are described in a four-page bulletin available from the *General Electric Company*, Schenectady 5, N. Y.

Designated as GEA-5729A, the two-color publication uses photographs, specification charts, and dimensional diagrams in discussing the application, performance, and features of these relays—which are designed to meet or better military specifications.

PRINTED CIRCUITRY

The first complete description of the *Technograph* process of printed circuits is now available in a new book which covers the processes and uses of printed circuits. The entire subject is treated at sufficient length to indoctrinate anyone interested in the future development of many electronic products through printed circuitry.

This hard-covered, 48-page book may be obtained at $1 a copy from Dept. T, *Technograph Printed Electronics*, 191 Main Street, Tarrytown, N. Y.

LIQUID-LEVEL CONTROL

A single-thyratron electronic liquid-level control operating without radio frequency from a single capacitive-type probe is described in Form LL-4-453. This four-page folder, published by *Thermo Instruments Co.*, 1166 El Camino Real, Belmont, Calif., illustrates the control and the probe, and contains alternative schematic arrangements for installation. Specifications are included.

MAGNETIC IRON POWDERS

Complete technical data on various magnetic iron powders, including photomicrographs, frequency vs. Q charts, and permeability rating graphs, are available from *Magnetic Powders, Inc.* These data are contained in an eight-page illustrated catalog, No. 354, which covers annealed carbonyl iron powders, hydrogen reduced iron powders, and magnatites. Write to Mr. C. C. Neighbors, *Magnetic Powders, Inc.*, 1047 Fairview Avenue, Johnsonburg, Pa., for your copy.

MAGNETIC AMPLIFIER CIRCUITS

Three Government research reports describe new magnetic amplifier circuits which make possible better computers and automatic control systems. These reports are available in mimeographed form from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., at 50 cents each. Orders should be accompanied by check or money order payable to the Treasurer of the United States.

The amplifier control circuits and their characteristics are described in PB 105747, entitled "On the Contro of Magnetic Amplifiers." PB 111033 "The Single-Core Magnetic Amplifie as a Computer Element," shows ho the new circuits can provide mor dependable elements in basic functiona components of computers. How th circuits can be used to provide anticipatory correction mechanisms is covered in PB 111022, "Lead Network Utilizing a Saturable Core Memory.

NBS REPORT

The National Bureau of Standard has published a ten-page report en titled "Machining of Powdered Iro Materials and Ferromagnetic Ferrites. It contains special techniques for th following materials: polyirons, ferrite and ground ferrites suspended in binders. Altogether, 28 individual materials are discussed.

This report (PB 108118) is availabl from the Library of Congress Publica tion Board Project, Washington 25 D. C., in microfilm or photostat for for $1.25. A limited supply is als available from the Microwave Laboratory, National Bureau of Standards Washington 25, D. C.

MICROWAVE COMPONENTS

"Microwave Components" is a con cise, well-illustrated bulletin featurin the use of *Crowley* polyiron—a perme able dielectric material—for microwav components. The bulletin also cover various kinds of terminations, stoc blank sizes, and machining procedures and includes drawings of typical polyiron fabrications. It is available to engineers and manufacturing executive from *Henry L. Crowley & Co., Inc.*, Central Ave., West Orange, N. J.

PRINTED CIRCUIT HANDBOOK

Methode Manufacturing Corporatio has announced the publication of printed circuit handbook entitled "Util ization of Prefabricated Wiring." Thi 32-page booklet provides comprehensiv and detailed engineering informatio on the practical application of printe wiring techniques to electronic equip ment. It will be sent to anyone request ing a copy on a business letterhead b *Methode Manufacturing Corporatio* 2021 W. Churchill St., Chicago 47, Il

WIRES AND CABLES

Copies of a 76-page booklet entitle "U. S. Electrical Wires and Cables fo the Chemical and Petroleum Industries, may be obtained from the Electrica Wire and Cable Department of th *United States Rubber Company*, 123 Avenue of the Americas, New York 2 N. Y.

Divided into four main sections—in- lation compounds, jacket compounds, nstruction, and technical data—the oklet follows the successful pattern U. S. *Rubber's* earlier book on the al mining industry. The compound :tions have been expanded to include tyl insulation, heat- and moisture- sistant insulations, thermoplastic pes, the general-purpose neoprene :ket, and the polyvinyl chloride type :ket.

ETALLIC RECTIFIER UNITS

The complete line of *G-E* metallic :tifier power conversion units is cov- :d in an eight-page bulletin available om the *General Electric Company*, henectady 5, N. Y.

Designated as GEA-5658B, this pub- ation lists the design features and vantages of the *G-E* line, and gives rformance data, circuits, dimensions d ratings. A guide is also provided an aid for preparing contract specifi- tions which entail *G-E* d.c. power oplies and exciters.

* * *

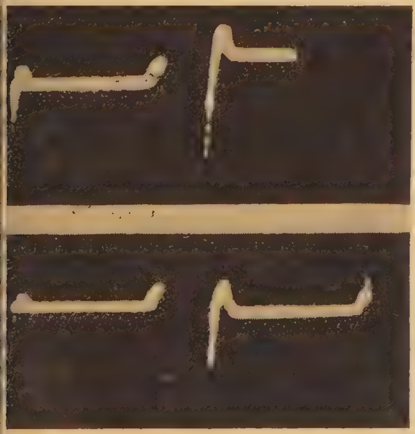
ectronic Flowmeter

'ontinued from page 14)

; system operating at a 10-cps rate is ployed. Switching is achieved by a nmutator which is inserted between crystals on one side and a 100-kc. :illator and receiver on the other. The :illator is connected to an amplifier ntaining carefully designed limiters it produce a square-wave voltage to injected on one grid of a multigrid asemeter tube. The receiver-amplifier o furnishes a limited signal to the ier grid of the phasemeter tube.

This phasemeter tube is bypassed by a acitor so that fluctuations at the und wave frequency are removed and :tuations at the switching rate may applied to a synchronized rectifier. e rectifier is actuated in synchronism :h the commutator, but its active riod is shorter, so that harmful transients occurring during the crystal transition are suppressed.

)scilloscope patterns for instantaneous ow velocities obtained with flowmeter.



A simple commutator, one that would merely switch the crystals alternately to the receiving and transmitting channels, is unsuitable because of the capacitive cross-coupling between the two channels. In order for the transmitted and received pulses to be absolutely representative of the separation between the crystals and the velocity of the fluid, there must be a minimum of coupling between the two channels. By very careful design of the commutator, the leakage capacitance can be reduced to about 5 x 10^{-5} μμfd., and much of the fringe effects and ground currents is eliminated.

The rotor of the commutator is made in the form of a sandwich, consisting of two pieces of insulating material fastened to a grounded conductive shield. Two conductive segments or sectors are mounted on the insulating material but have no connection to the shield. The shield is brought out to the maximum diameter of the rotor, thereby reducing the fringe effects between the sectors. Four rows of carbon brushes are arranged so that the crystals are connected to either the receiver or oscillator for all positions of the rotor. Capacitive coupling between the sectors is reduced by maintaining a clearance of less than 0.015" between the sector shield and the rotor. Similarly, close-fitting shields are provided at the ends of the rotor to assist in reducing fringe effects.

The output of the phasemeter is applied to an electronic high-impedance voltmeter (which can be calibrated directly in terms of velocity) through the rectifier-switch geared to the commutator drive. Fast velocity changes can be observed on the screen of a cathode-ray oscilloscope connected to the plate of the phasemeter tube. Thus, if the plate voltage is made visible, the difference between the voltages developed "upstream" and "downstream" can be used directly to estimate the flow velocity instantaneously.

The commutation operation can be modified by the use of an electronic switch. By using vacuum tubes, the switching frequency can be increased to 1000 cycles, for example, and the time of response can be correspondingly shortened. Four pentode amplifiers are placed between the crystals on one side and the oscillator and receiver on the other. The screen-grid supply is derived from a square-wave generator with a frequency equal to the switching rate (1000 cps).When the screen voltage is positive, the pentode acts as a normal amplifier; when the potential becomes negative, the electron stream in the tube is blocked and good shielding is provided. The amplifiers are so arranged that one pair operates at a time during each half of the switching cycle.

Further modifications in the flowmeter are being considered; one in particular is concerned with flow in metal pipes. A pulsed and gated phase comparison system will be used for this purpose to eliminate the effects of the direct transmission of the sound through the wall of the pipe.

* * *

Pulse Duration Modulation

(Continued from page 11)

AM and PAM, where slicing is not available.

The primary disadvantages of PDM are:

1. In comparison with FM and AM, PDM requires a greater bandwidth which is traded for an improved signal-to-noise ratio.
2. It does not utilize transmitter energy as effectively as all the other pulse systems which maintain constant narrow pulses.

REFERENCES:

1. *Libois, L. J., "Application of Pulse Modulation to the Transmission of a Carrier Telephone System Channel Groups," L'onde 'Electrique (Paris), April-May,* 1952.
2. *Fitch, E., "The Spectrum of Modulated Pulses," Jour. I.E.E. (London),* 1947, *Vol.* 94, *Part IIIA, pp.* 556-64.
3. *Lozier, J. C., "Spectrum Analysis of Pulse Modulated Waves," Bell System Tech. Jour., April,* 1947, *Vol.* 26, *pp.* 360-387.

* * *

PLANS
INTO
PLASTICS

PRECISION MACHINING
OF ALL THE PLASTICS
including

POLYSTYRENE COPOLYMER 1422
BUTYRATE TEFLON
NYLON KEL-F

PLASTIC FABRICATING

Printloid is equipped for the complete production of a wide variety of consumer and industrial items in any quantity. We work with any plastic material in sheets, rods and tubes. Die-cutting, deep drawing, stamping, forming, finishing, and assembling in our own plant.

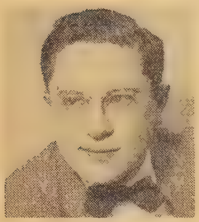
PLASTIC PRINTING

LETTERPRESS . . . SILK SCREEN
HOT STAMPING
for Containers, Displays, Dials, Charts, Machined Parts, Etc.

Ask for brochure illustrating various plastic products fabricated to specification by Printloid.

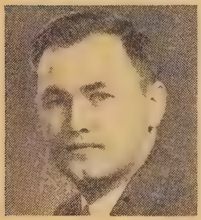
PRINTLOID, INC.
95 Mercer St., N. Y. 12, N. Y.

Personals



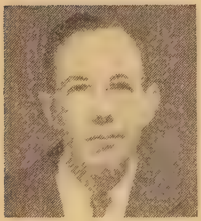
ALTON D. ANDERSON has been named assistant chief engineer of *Cook Research Laboratories*, a division of *Cook Electric Company*, Chicago, Ill. Since 1950, Mr. Anderson has been director of the Systems Development Section; now he will coordinate the activities of the various technical sections of the *Laboratories* and assist in the direction of over-all technical programs. Prior to 1950, Mr. Anderson was associated with the Naval Ordnance Laboratory.

DR. SEYMOUR B. COHN, an authority on microwave components, has joined the staff of Stanford Research Institute to head the Microwave Group in the Aircraft Radiation Systems Laboratory; he was formerly a research engineer at *Sperry Gyroscope Company.* During the war years, Dr. Cohn worked as a special research associate in the Radio Research Laboratory at Harvard University. He holds the 1942 Lamphier Award from Yale University.



JOHN A. DOREMUS, well known for his work in the communications field—and more specifically for his contribution to transistor development, has been appointed director of engineering of the *Allen D. Cardwell Mfg. Corp.*, Plainville, Conn. He will be responsible for the company's engineering research as well as engineering supervision of government projects. Mr. Doremus was formerly chief engineer of the Carrier & Control Division, *Motorola, Inc.*

KENNETH A. HOAGLAND, formerly assistant engineering manager of the Cathode-Ray Tube Division of *Allen B. Du Mont Laboratories, Inc.*, has now been named chief engineer of this division. One of the outstanding cathode-ray tube experts in the field, Mr. Hoagland has been with the *Du Mont* organization for 12 years. He is credited with the development of the *Du Mont* "Bent Gun" used in cathode-ray tubes and with the "Selfocus" picture tube.



GEORGE J. ROGERS has joined the Electronics Division of the National Bureau of Standards. As a member of the Engineering Electronics Section, he will be engaged in the development of miniaturized equipment. Before joining NBS, Mr. Rogers was an electronics engineer with the *Engineer Research and Development Laboratories*, Ft. Belvoir, Va., where he assisted in the development of electronic mine-detecting equipment for metallic and non-metallic mines.

MARVIN G. WHITNEY has been appointed assistant to the president of *Hoffman Radio Corp.*, Los Angeles, Calif., with a current assignment on television engineering, quality control and product design. A graduate of Rensselaer Polytechnic Institute, he was with *Radio Corporation of America* for 13 years in various product and plant manager capacities, first at Camden, N. J., and more recently at the new *RCA* engineering plant at Moorestown, N. J.

New Products

(*Continued from page* 21)

tional information, may be secured fro the Electronics Division of *The Kuljia Corporation,* 1200 N. Broad Stree Philadelphia 21, Pa.

PRECISION RANGE CALIBRATOR

Measurements within 10 feet fo ranges up to 10,000 yards are possibl with the Model 531 precision rang calibrator just announced by the *Brist Engineering Corp.*, Lincoln Avenue an

Pond Street, Bristol, Pa. Designed fo both laboratory and field use, the Mod 531 may be used for radar developmen and test work, computer measurement and time base measurements on cathod ray tube displays.

The basic circuit consists of an accu rate range mark generator, a conti uously variable delayed pulse and built-in coincidence and calibrating ci cuit. By calibrating the variable puls to a marker close to the desired rang great accuracy can be obtained with minimum of complexity.

SIGNAL GENERATOR

A new signal generator, Model 618 has been designed by *Hewlett-Packar Company* for faster and more accura measurements of radio relay, radar, T carrier systems, and similar applic

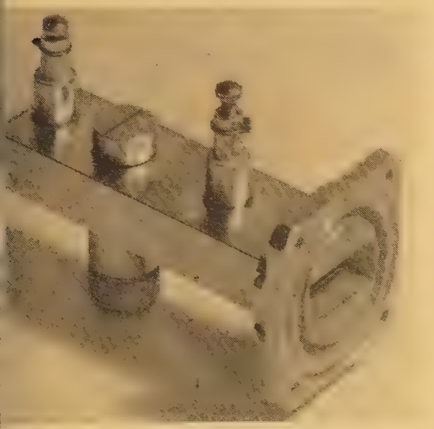
tions involving superhigh frequencie It is equipped with a reflex klystr oscillator for frequency generation a covers a range of 3800 to 7600 mc.

Model 618B has wide pulsing capab ities; it may be internally or externa pulse modulated. The repetition rate continuously variable from 40 to 40 lses per second, and pulse width is riable from 0.5 to 10 microseconds. r further information, write to *Hew- t-Packard Company*, 395 Page Mill ad, Palo Alto, Calif.

YSTAL DETECTOR

Another new product has been added the expanding line of specialized mi- owave components being developed by *neral Precision Laboratory*, Pleasant- lle, N. Y.—a tunable crystal detector now available in RG-52/U or RG- /U wave guide.

This unit, for use in the range from 00 to 9500 mc., utilizes two screws for ljusting to optimum VSWR. Its sim- icity of design and ease of operation present an advance over earlier crys- l detector designs.



ARBON FILM RESISTORS

Production of two high-stability car- n film resistors has begun at the *hase Resistor Company*. One type of it is sealed in a glass envelope, evac- ted, baked at high temperature un- r vacuum, and finally sealed in heli- n of spectroscopic purity. This unit stable to .01% under all environmen- l conditions, and has a long-time drift .01% per year or less. It can be sup- ied in networks with ratios and tem- rature coefficients held to very close lerances.

A less expensive unit is made by sol- r-sealing the resistor in a ceramic be with metallized ends. The stability this unit is less than that of the ass-helium sealed resistor, but much tter than that of a varnished resistor, rticularly under conditions of high midity and temperature.

Free literature and sample card for ysical dimensions are available upon quest on company stationery from *hase Resistor Co.*, 9 River Street, Mor- stown, N. J.

JLL DETECTOR

Primarily intended for use as a bal- ce indicator for a.c. bridges, the Type 1212-A unit null detector is also useful as a sensitive wide-frequency-range voltage indicator. Its frequency characteristic is flat within about 1 db from 50 cycles to 500 kc., and it is satisfactory as an indicator at frequencies from 20 cycles to 5 mc.

Type 1212-A is one of the building-block instruments in the unit line being manufactured by *General Radio Company*, 275 Massachusetts Ave., Cambridge 39, Mass. An approximately logarithmic relationship between meter reading and input voltage gives an on-scale range of about 120 db. The full-scale deflection is about 100 volts, while a signal of less than 40 microvolts deflects the meter by 1% of full scale.

MINIATURIZED BALANCE PANEL

Constructed entirely of miniaturized components, the Model BP-2 15-channel balance panel is designed specifically for use in flight test instrumentation and other applications where multiple-

A "LOUDSPEAKER" CLUTCH

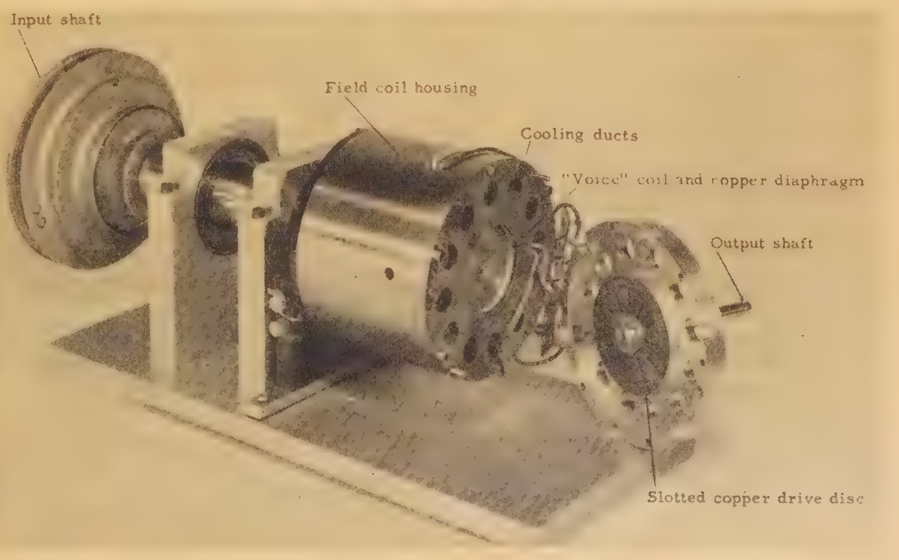
A FAST-ACTING CLUTCH that works on the same moving-coil principle as the electrodynamic loudspeaker of an ordinary radio receiver has been developed by the National Bureau of Standards. The new clutch is activated by applying direct current to a coil located in a constant magnetic field. The force resulting from the interaction of the coil current and the magnetic field moves the coil and causes the clutch output disc to be pressed against the rotating input members. In an experimental model constructed at NBS, full output-shaft torque—10 ounce-inches maximum—was attained in less than a third of a millisecond after application of the actuating voltage. Developed by Jacob Rabinow, head of the NBS Electromechanical Ordnance Division, the NBS "loudspeaker" clutch offers advantages for certain instrumentation and computer applications calling for fast response. Possible uses include rapid starting and stopping of magnetic wire or tape recording media in high speed electronic computers, like the Bureau's SEAC, and high speed switching in telephone dial systems.

In the NBS experimental model, the magnets and coils rotate with the clutch input shaft. Although a permanent magnet could be used, an electromagnet was chosen; the clutch can thus be easily cleaned of any accumulated magnetic particles when the magnetizing current is shut off. Two pairs of slip rings transmit the magnetizing and actuating currents to the rotating assembly. A thin flexible diaphragm is fastened to the actuating coil. When the voltage is applied, the coil jumps forward and presses the clutch output disc between the rotating diaphragm and a backing disc which is also rotating. Vent holes in the output disc, diaphragm, and case assist cooling and avoid compression or rarefaction of air by the diaphragm.

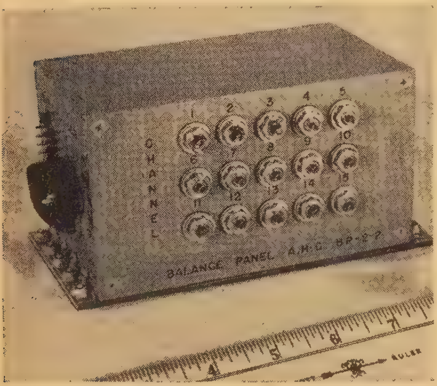
Compensating coils are attached to the pole faces of the electromagnet, close to the actuating coils. All of the coils are connected in series so that the current is the same in all windings, but the direction of current flow in the compensating coils is opposite to that in the actuating coils. This arrangement cancels out the inductance of the actuating coils to the extent that the coupling between coils approaches unity, and thus minimizes the time required for current to rise in the coils after the actuating voltage is applied.

The principle of the NBS loudspeaker clutch is expected to find application in specialized equipment where light loads must be accelerated at an extremely rapid rate. A similar principle has already been used at the Bureau to advance frames of photographic film rapidly at random intervals of time. Although the actuating mechanism rotates in the experimental clutch model described, an alternative design has been drawn up in which the actuating means are stationary and operate the clutching means through thrust bearings.

Partially disassembled model of the "loudspeaker" type clutch. This clutch is actuated by applying voltage to a "voice coil" mounted in a magnetic field.



channel data recording is required and where the weight and size of the instrumentation must be kept to a minimum. Applications include electrical balancing of circuits involving strain gauges, accelerometers, position pickups, and any sensing devices that operate in electrical bridge circuits.



Just announced by the *American Helicopter Co., Inc.*, 1800 Rosecrans Ave., Manhattan Beach, Calif., the unit incorporates miniature 10-turn balancing potentiometers which have a linearity of ± 0.5%. Precision, wire-wound resistors used for calibration—having an accuracy of ± 0.1%—are included.

DELAY CABLE

A high-impedance cable designed to delay signals (both sine waves and pulses) for periods from a fraction of one microsecond to several microseconds is being manufactured by *Columbia Technical Corporation*, 5 East 57th Street, New York 22, N. Y. Its primary application is in electronic circuits where minimum attenuation and signal distortion are required as well as fast rise time.

Type HH-2000 has a time delay of 0.11 microsecond per foot, and a nominal characteristic impedance of 2200 ohms. The attenuation for a delay of one microsecond is practically zero up to 3 mc., 0.5 db at 5 mc., and 2.5 db at 10 mc. The bandwidth for a one-microsecond delay is more than 0-10 mc., and correspondingly larger for smaller time delays. Compared to the commonly used RG-65/U cable, HH-2000 requires about two-thirds less cable length for a given delay.

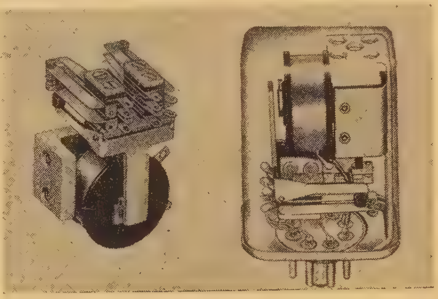
TECHNICAL PAPERS WANTED

CONTINUED growth and the acceptance accorded this publication shows the need for expanding our editorial coverage. Engineers are requested to submit papers on the following subjects: microwaves, color TV, transistors, industrial electronics, communications, instrumentation, and circuitry. If acceptable, such papers will be paid for at our current rates upon acceptance.

Address all inquiries to H. S. Renne, RADIO-ELECTRONIC ENGINEERING, 366 Madison Avenue, New York 17, N. Y. Telephone MUrray Hill 7-8080.

RELAYS

Small, lightweight, 400-cycle a.c. relays, designed to withstand better than 10*G* vibration in aircraft equipment, have been developed by *Potter and Brumfield*. They are available in either open (shown at left in photograph) or hermetically sealed types.



Both types are furnished with two Form C fine silver contacts rated up to 5 amperes at 115 volts a.c., or 28 volts d.c., noninductive load. Contact pressure is 15 grams or higher at approximately 2 volt-amperes input per pole. Coils are wound on molded bakelite bobbins with a minimum breakdown of 500 volts r.m.s. between all current-carrying elements and ground.

The AF Series relays can be supplied with plug-in or solder terminals and glass-insulated headers. For further details, write to *Potter and Brumfield*, Princeton, Indiana.

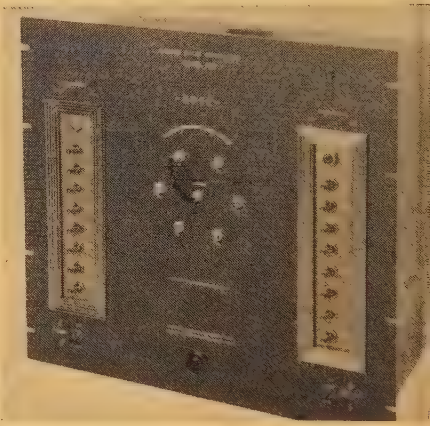
ELECTRONIC COUNTER

Completely contained in a small, bench-size unit, Model 522B is a new all-purpose precision counter which provides frequency, period and time interval measurements over a broad range. Operating and application details are available from *Hewlett-Packard Company*, 395 Page Mill Road, Palo Alto, Calif.

Model 522B measures rate of occurrences from .00001 to 100,000 per second and time from 10 microseconds to 27. hours. Counting is available over periods of 1/1000, 1/100, 1/10, 1 and 1 seconds or multiples thereof. Time o display can be varied to any duration counts are automatically reset, an action is repetitive. Results are show in cycles per second, kilocycles, second or milliseconds, and are displayed instantly and automatically in direct reading form.

SQUARE PULSE GENERATOR

Electrical and Physical Instrumen Corporation, 42-19 27th Street, Lon Island City, New York, has announce the Model 200 square pulse generato It incorporates a new method of puls shaping which provides square pulse of 0.001 μsec. rise time with a comparable delay time, and a pulse width tha can be varied from 0.001 μsec. to several microseconds. The maximum puls amplitude is 100 volts into low impedance cables for a pulsed power outpu of 200 watts.



The Model 200 provides two simultaneous pulse outputs, each of whic can be individually attenuated and delayed. Output amplitude can be attenuated 84 db in 1-db steps by means o front panel attenuator switches t cover the range of 100 volts to 0.00

CALENDAR
of Coming Events

AUGUST 19-21 — Western Electronic Show and Convention, Civic Auditorium, San Francisco, Calif.

SEPTEMBER 1-3—International Sight and Sound Exposition, Palmer House, Chicago, Ill.

SEPTEMBER 21-25—Eighth National Instrument Exhibit, Hotel Sherman, Chicago, Ill.

SEPTEMBER 28-30—National Electronics Conference, Hotel Sherman, Chicago, Ill.

OCTOBER 26-28—**IRE-RTMA** Radio Fall Meeting, Toronto, Ontario.

ts. A polarity switch allows selection positive or negative pulses.

NDPASS FILTER

Model 310-A, anounced by the *Krohn-te Instrument Company*, is an adjust-.e bandpass filter with unity pass in and 24 db/octave slopes outside the ssband. A peaking factor is used to luce the attenuation at the cutoff quencies. Both high and low cutoff quencies are independently adjust-e from 20 cps to 200 kc., providing ximum flexibility of adjustment of h the band center frequency and the ndwidth.

This filter is especially useful in the dio and ultrasonic frequency range noise measurements, harmonic and quency analysis, and for psycho-ustics and electromedical research. descriptive pamphlet is available on quest from the *Krohn-Hite Instru-nt Company*, 580 Massachusetts Ave-, Cambridge 39, Mass.

INIRANGE TEST SET

The ILS signal generator Model AEC- is a new portable unit which pro-es simulated omniphase, ILS, and e ILS signals for laboratory or ramp ting of airborne v.h.f. and naviga- n radio gear. Designed and manu-tured by *American Electroneering poration*, 5025-29 Jefferson Blvd., Angeles, Calif., the set checks omni-rings continuously variable from 0° to 360°, and assures accuracy to 1°. In addition, it will check left-center-right, and up-center-down on a 90-150 localizer and glide slope. A self-contained, regulated dual power supply utilizes either 105-130 volts a.c. at 60 cycles, or 22-30 volts d.c. at 5 amperes.

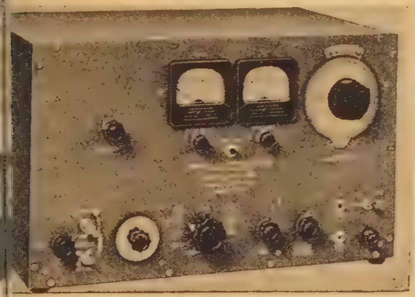


Photo Credits

AGE	CREDIT
....	Westinghouse Electric Corp.
, 7......	Ryan Aeronautical Corp.
4, 29..	Nat. Bureau of Standards

Oscilloscope Calibrator

(*Continued from page* 16)

the potentiometer the first division between "Off" and 10 is 50°—to take care of the potentiometer switch on-off action—and that the first division starts at 10 to take into account the "end" resistance with the switch just on. The succeeding angular divisions are all 30° (making a total of 270° between 10 and 100).

In calibrating the calibrator, one should start out by setting the potentiometer shaft at clockwise rotation and locking the knob at 100 on the dial. The calibrator may then be connected to any oscilloscope and set for line frequency calibration. An a.c. signal of known r.m.s. value is applied to the oscilloscope through the calibrator by placing the calibrator multiplier on "Signal" position. The scope vertical gain should be adjusted to give a selected number of squares (or amplitude) on the scope screen. The a.c. voltage multiplied by 2.82 gives its peak-to-peak value, which is then set on the calibrator's dials. The calibration adjustment of the calibrator should be set to give the same amplitude on the oscilloscope as the previous signal produced.

The aluminum box used to house the calibrator has a 6" x 9" panel which is large enough for all the controls required. A 2" x 4" x 8" chassis offers more than adequate mounting room for all the components. The wiring diagram indicates that the signal and output leads should be shielded. Preferably, one of the new *General Electric* 400-volt germanium power rectifiers should be used to minimize voltage drop, improve the power supply voltage regulation, and thus take some of the load off the VR tube. Otherwise, all other constructional details are largely a matter of personal taste.

REFERENCE:

1. *Kaufman, Alvin B., "Potentiometer Loading Errors," Radio-Electronic Engineering, September*, 1952.

RAPID COMPONENT TESTING

By JAMES R. FORD

BY utilizing the fluidity and conductivity of mercury, it is possible to provide a very rapid method of testing large numbers of a given component in the same circuit.

Multiterminaled transformers and relays are examples of components with which a technique of this type can profitably be used. In particular, it was found to be an extremely efficient method of testing batches of blocking oscillator transformers.

This particular application required that contact be made to six leads; therefore, a block of good dielectric material with feedthrough contacts at the bottom of six counterbored holes was used as the mercury container. The holes were drilled so that they would be in alignment with the terminals of the transformer. The block was then placed in the circuit in such a manner as to maintain critical lead spacing and routing from unit to unit, as well as to add minimum stray capacity to the circuit.

Final mounting of the unit containing the "mercury block" is such that the holes are approximately vertical. Mercury can be easily applied to the proper depth in each hole by the use of a very small-bore eye dropper. The unit is then ready for transformers to be quickly placed in the circuit and taken out again.

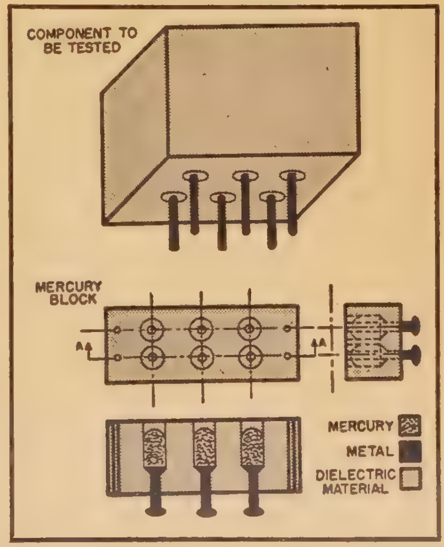
Obviously, a technique of this type is warranted only when there are a large number of leads per component and/or a large number of components to be tested rapidly.

Greater flexibility of unit position can be attained by pressure-mounting the components, using a simple clip-on method. This can be accomplished without greatly affecting replaceability, but it rather drastically complicates the "mercury block" design.

Although the conductivity of mercury is approximately 1/54th that of copper, it is not difficult to keep the mercury resistance plus contact resistance to less than 0.05 ohms; therefore, in general, the relatively low conductivity is not too serious a limitation.

Amalgamation of other metals by mercury is purported to be a consideration with the use of mercury. However, no degrading effect has been noted thus far by the author.

Sketch of the mercury block.



URSI-IRE MEETING

Joint meeting of USA National Committee of URSI and IRE Professional Group on Antennas and Propagation.

THE International Scientific Radio Union is one of several world scientific unions organized in 1919 under a general organization now called the International Council of Scientific Unions. It is commonly designated as the URSI from its French name, Union Radio Scientifique Internationale.

The USA National Committee of the URSI usually holds two meetings a year jointly with the Professional Group on Antennas and Propagation of the IRE. The latest meeting was held in Washington, D. C., April 27-30, at which approximately 85 papers were presented. Not intended to be a complete review of all of these papers, the following report will serve to outline a few highlights of the meeting.

Lightning

The subject of lightning was discussed quite extensively, with emphasis on radio interference caused by lightning. Various phases of the work being done were reported on by: A. W. Sullivan, J. D. Wells and W. J. Kessler, of the University of Florida; M. M. Newman and J. R. Anderson, of the Lightning and Transients Institute; and S. E. Reynolds, of the New Mexico Institute of Mining and Technology.

A program for coordinated lightning measurements is under way in Florida, New Mexico and Minnesota. Each laboratory composes an apex of a triangulation system for directional and waveshape propagation measurements. Equipment for synchronizing measurements accurately at the various locations was described, and the problems inherent in such widely spaced measurements were analyzed. Characteristics to be studied include: polarity distribution of interfering impulses; typical duration, rates of rise, and peak values of impulses; average duration of static bursts; and representative number of bursts per minute with reference to storm intensity and distance.

An artificial lightning generator was demonstrated. This generator consists of a multiplicity of condensers arranged to simulate the natural discharge path of lightning. Long discharge channels can thus be established at a relatively low starting voltage, permitting a more intensive study of sferics (atmospheric noise) at close range. In the demonstration, a 20,000-volt flash was caused to travel a distance of about two feet.

Noise Measurements

Measurements were made at the University of Florida on the effect of atmospheric noise on the reception of speech to determine the per cent of message error under various degrees of noise intensity. The relationship between the S/N ratio and per cent of message error was found to be practically identical for the five S/N ratios employed. It was also found that message errors in the presence of noise depend upon message complexity as well as S/N ratio.

A new type of noise-measuring instrument called the "Stochastimeter" was described. With this instrument, it is possible to make direct measurements of the average value of the noise envelope, the probability distribution, and the average number of noise pulses that exceed any given amplitude level. From these direct measurements, it is possible to calculate the average width of the noise pulses at any amplitude level and the average time between pulses at any amplitude level.

Another type of noise meter was also presented. This meter, developed at the University of Florida, may be termed a wide-range panoramic noise meter. It was designed specifically for the rapid indication of S/N ratios over a frequency range of 1-25 mc. and a dynamic range of 110 db. The full range may be recorded on a continuous paper strip, or smaller segments up to 200 kc. in width can be displayed oscillographically to permit detailed observation and study of any segment in the 1-25 mc. range.

Miscellaneous

Several papers presented at the meeting dealt with measurements of various kinds. Some of these will be reviewed briefly.

David M. Kerns, of the National Bureau of Standards, presented a paper which was prepared jointly with Alan C. Macpheson entitled "A New SWR Measurement Technique." Precision of the order of .03% has been attained, although the technique at the present time applies only to sliding loads and yields only the magnitude of the SWR. In the technique, an H-plane junction provided with a transformer in its si arm is utilized. The r.f. source and tector are connected to the symmetri arms of the junction. The transform is adjusted for no reflection, looking to the side arm. Observation of detect response vs. load position yields t SWR pattern.

C. Wellard, of the *International* *sistance Company*, discussed a n method for determining resistor p formance in the 2-400 mc. band. resonant cavity is employed along wi conventional, commercially availa equipment, and the resistance variati and susceptance variation princip are employed. Accuracy is within 5 Tables have been compiled which ma the determination of a.c. resistan rapid. Resistors of conventional desi up to 2-watt ratings may be measure

William F. Gabriel, Naval Resear Laboratory, described a broadband, l power, automatic impedance record of good accuracy which has been dev oped for the X-band. An r.f. impedan circuit utilizing broadband wave gui components extracts the amplitude a phase information which operates el tromechanical servos in the amplifie recorder unit. Any incident r.f. pow level between 20 and 250 mw. may used.

H. A. Finke, of the *Polytechnic* *search and Development Company*, a alyzed various methods of measuri power at microwave frequencies. T bolometer method was analyzed, a errors associated with its use were d cussed. A bolometer was describ which has a VSWR of less than from 500 to 10,000 mc., with a pow efficiency of 97.5% at 5000 mc.

A radio-frequency permeameter w discussed by Peter H. Haas, of NE With this equipment, measurement made by inserting a toroidal core in the short-circuited secondary of transformer whose primary is attach to an r.f. bridge or Q meter. A dev similar to this unit is currently bei manufactured by the *National El* *tronic Laboratories, Inc.*, Washingt D. C.

A dummy load with a high pow rating was described by Dr. H. Brue mann, of the Signal Corps Electron Laboratory. This load consists of sta less steel wire wound in a helix of u form diameter and pitch, supported a coaxial ceramic form, and shielded a metal tube. The helix acts as a u form transmission line similar to a lay line, and has relatively high atte ation. Cooling by air can be eas achieved, and an experimental mo was described which was rated at kw. from 3 to 30 mc. Input impeda was 600 ohms balanced to ground. Co pactness and low weight are featu of the unit.

ADVANCE! Raise your earning power—learn RADIO-TELEVISION-ELECTRONICS by SHOP-METHOD HOME TRAINING

GOOD JOBS AWAIT THE TRAINED RADIO-TV TECHNICIAN

here is a place for *you* in the great Radio-Television-lectronics industry when you are trained as National chools will train you at home!

Trained technicians are in growing demand at good pay in manufacturing, broadcasting, television, communica-ons, radar, research laboratories, home Radio-TV service, nd other branches of the field. National Schools Master hop-Method Home Training, with newly added lessons nd equipment, trains you in your spare time, right in our own home, for these fascinating opportunities. UR METHOD IS PROVED BY THE SUCCESS OF ATIONAL SCHOOLS TRAINED MEN, ALL OVER HE WORLD, SINCE 1905.

EARN WHILE YOU LEARN

any National students pay for all or part of their train-g with spare time earnings. We'll show you how you can o the same! Early in your training, you receive "Spare-me Work" Lessons which will enable you to earn extra oney servicing neighbors' and friends' Radio and Tele-ision receivers, appliances, etc.

MASTER ALL PHASES!

Get Master Shop-Method Home Training from an Established Practical Resident School with its own Training Shops, Laboratories, Studios — almost 50 Years of Successful Experience in Training Ambitious Men.

We Bring National Schools To You!

ational Schools Training is All-Embracing

ational Schools prepares you for your choice of many b opportunities. Thousands of home, portable, and auto dios are being sold daily—more than ever before. Tele-ision is sweeping the country, too. Co-axial cables are ow bringing Television to more cities, towns, and farms very day! National Schools' *complete* training program ualifies you in all fields. Read this partial list of opportu-ities for trained technicians:

- Business of Your Own • Broadcasting
- Radio Manufacturing, Sales, Service • Telecasting
- Television Manufacturing, Sales, Service
- Laboratories: Installation, Maintenance of Electronic Equipment
- Electrolysis, Call Systems
- Garages: Auto Radio Sales, Service
- Sound Systems and Telephone Companies, Engineering Firms
- Theatre Sound Systems, Police Radio
- And scores of other good jobs in many related fields.

TELEVISION TRAINING

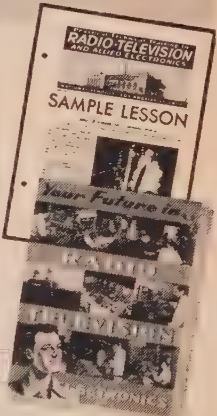
You get a complete series of up-to-the-minute lessons covering all phases of repairing, servicing and construction. The same lesson texts used by resident students in our modern and complete Television broadcast studios, laboratories and classrooms!

LEARN BY DOING

You receive and keep all the modern equipment shown above, including tubes and valuable, professional quality Multitester. *No extra charges.*

FREE! RADIO-TV BOOK AND SAMPLE LESSON!

Send *today* for National Schools' new, illustrated Book of Opportunity in Radio-Television-Electronics, and an actual Sample Lesson. No cost—no obligation. Use the coupon now—we'll answer by return airmail.



APPROVED FOR VETERANS AND NON-VETERANS
Check coupon below

Both Resident and Home Study Courses Offered!

NATIONAL SCHOOLS

LOS ANGELES 37, CALIFORNIA • ESTABLISHED 1905
IN CANADA: 193 E. HASTINGS STREET, VANCOUVER, B.C.

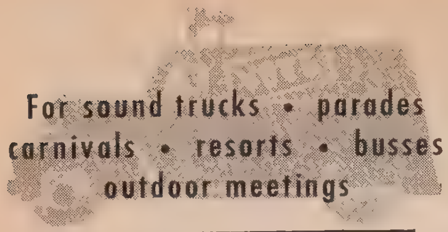
FIND OUT NOW—MAIL COUPON TODAY!

NATIONAL SCHOOLS, Dept. RH-73
4000 South Figueroa Street
Los Angeles 37, California

Mail in envelope or paste on postal card.

Send FREE Radio-TV Electronics book and FREE sample lesson. I understand no salesman will call on me.

NAME__________________________AGE____
ADDRESS______________________________
CITY________________ZONE____STATE______
☐ Check here if released from service less than 4 years ago.
☐ Check here if interested in Resident Training at Los Angeles.



ECONOMICAL MOBILE AMPLIFIERS by Newcomb

Newcomb mobile amplifiers are carefully built for the rugged conditions of mobile use and to deliver consistently the top quality performance you expect from any Newcomb amplifier. Dollar for dollar they give you more good service, more convenient operational features and more all around, long-time satisfaction.

MODEL E-25MP delivers 25 watts from either 6 volt battery or 117 A.C. It has a standby switch, separate power and phono switches and inputs for 2 mikes and 1 phono. Heavy duty plugs. 2000 volt hermetically sealed buffer condenser. Phase correction capacitator for phono motor.

MODEL E-25M is the same amplifier without phono top.

MODEL E-10M is a rugged, low cost, 10 watt unit also for either battery or A.C. power. Has standby switch, inputs for 1 mike, 1 phono. Special mounting simplifies installation and removal.

NEWCOMB
AUDIO PRODUCTS CO.
Dept. F, 6824 Lexington Ave., Hollywood 38, Calif.

Spot Radio News

★ **Presenting latest information on the Radio Industry.**

By RADIO & TELEVISION NEWS'
WASHINGTON EDITOR

THE CONGRESSIONAL CRUSADE for color TV, sparked three years ago by the volatile Senator from the West, Edwin C. Johnson, and refired a few months ago through bristling letters to his colleagues demanding a probe to learn, unequivocally, why we still have no panchromatic sets, reached a new beachhead a few weeks ago, and with historic results. During a 48-hour trek to Princeton, N. J., and New York City, members of the House Commerce Committee witnessed impressive demonstrations of compatible NTSC color. With their chairman, Rep. Charles A. Wolverton, the group (which included Reps. John W. Heselton, William L. Springer, Joseph P. O'Hara, Joseph L. Carrigg, J. P. Priest, Homer Thornberry, Herbert B. Warburton, John B. Williams, J. A. Younger, Carl Hinshaw, S. B. Derounian, D. L. Rogers, A. G. Klein, and W. T. Cranahan), saw the best color pictures ever shown, and they were excited over the results. So enthusiastic was the committee's headman that he urged that NTSC color be approved quickly so that sets . . . "can become available this Christmas."

In the tests at Princeton, three tricolor sets were on view. Two used sixteen-inch tubes providing 9 by 12-inch pictures, and another had a twenty-one inch picture tube which produced 12 by 16-inch pictures. The program, a 20-minute production, originated in the Colonial Theatre, in New York City, was fed to the Empire State transmitters and microwaved to Princeton, 45 miles away.

Field-sequential also received a viewing at the *CBS* studios in New York City, with indifferent results. The Congressmen also saw a slide-show on *Chromatic* tubes, which did not seem to impress them too much. It was felt that the pictures were, in the main, too bright and blurred. This defect, it was said, can be overcome. Commenting on a development now under way to modify the tube, a company spokesman declared that the new tubes would offer improved results and on larger screens; a 28-inch rectangular type with a short neck was now in the tooling stage.

The successful show at Princeton also brought huzzahs from Senator Johnson. In a note to David Sarnoff, which disclosed that a professional staff member of the Senate Intersta and Foreign Commerce Committ had witnessed a special demonstrati of color two weeks prior to the te held for the House Committee, t Senator praised Mr. Sarnoff for h vision in the development of color. am convinced that under your leade ship and driving force, compatib color television will become a realit in spite of all obstacles," said t Senator. "Many will throw rocks you," he added, "because of your d termination and strong militant effc to give color television to the peop now. Do not let them dismay you."

Emphasizing that the fight for co patible color was just and in the pu lic interest, the Senator pointed o that he will continue to offer eve assistance at his command . . . " that this great advancement in t art of communications becomes ava able to the people."

"Your efforts in devising a compa ible color TV system will long be r membered as a magnificent achiev ment of science," the Senator's lett declared. "For reasons best known themselves, there may be those w may desire to drag their feet at th point," the former committee cha man warned. "Please do not all them to slow you down. You are the right track. Please keep up t steam."

Even *Columbia,* who earlier h testified that they had given up t fight for field sequential, indicat that compatible color as demonstrat offered interesting possibilities a now would like to conduct spec NTSC tests over its New York C facilities. Special permission to te cast compatible color signals w granted by the Commission shor after *CBS* submitted its request.

Notwithstanding the rousing rece tion from Congressmen, industry terest in color remained calm. M felt that color was still in the stage. Speaking at a dinner in N York City, the prexy of *Admi* bluntly declared that industry . "has to have the right color pictu tube and the right tube simply does exist at present . . ." He pointed that there are in labs color receiv which produce excellent results, the color tube is still the probl child. Satisfactory types that available, he added, are . . . "

FREE

MONEY MAKING
FCC
Commercial·Radio Operator
LICENSE
INFORMATION

TELLS HOW–

WE GUARANTEE
TO TRAIN AND COACH YOU AT HOME
IN SPARE TIME UNTIL YOU GET
YOUR FCC
LICENSE

you have had any practical
ierience — Amateur, Army,
vy, radio repair, or experi-
nting.

Here is your guarantee

If you fail to pass your Commercial License exam after completing our course, we guarantee to continue your training without additional cost of any kind, until you successfully obtain your Commercial license, provided you first sit for this examination within 90 days after completing your course.

TV Engineering INCLUDED IN OUR TRAINING AND COACHING

TELLS HOW–

**IR AMAZINGLY EFFECTIVE JOB-FINDING
RVICE HELPS CIRE STUDENTS GET BET-
R JOBS. HERE ARE JUST A FEW RECENT
AMPLES OF JOB-FINDING RESULTS:**

GETS CIVIL SERVICE JOB

anks to your course I obtained my 2nd phone license,
am now employed by Civil Service at Great Lakes
val Training Station as an Equipment Specialist."
enneth R. Leiser, Fair Oaks, Mtd. Del., McHenry, Ill.

GETS STATE POLICE JOB

ave obtained my 1st class ticket (thanks to your school)
since receiving same I have held good jobs at all
es. I am now Chief Radio Operator with the Kentucky
e Police." Edwin Healy, 264 E. 3rd St., London, Ky.

GETS BROADCAST JOB

vish to thank your Job-Finding Service for the help in
ring for me the position of transmitter operator here
WCAE, in Pittsburgh."
Walter Koschik, 1442 Ridge Ave., N. Braddock, Pa.

GETS AIRLINES JOB

e to your Job-Finding Service, I have been getting
y offers from all over the country, and I have taken
ob with Capital Airlines in Chicago, as a Radio
hanic."
Harry Clare, 4537 S. Drexel Blvd., Chicago, Ill.

TELLS HOW–

EMPLOYERS MAKE JOB OFFERS LIKE THESE TO OUR GRADUATES EVERY MONTH!

Letter from nationally-known Airlines, "We would also appreciate if you would place the following additional advertisement in your bulletin—Wanted—Superintendent of Communications . . . Salary $666.66 per month."

Letter from nationally known airplane manufacturer, "We need men with electronic training or experience in radar maintenance to perform operational check-out of radar and other electronics systems . . . starting salary . . . amounting to $329.33 per month."

Letter from nationally-known Airlines, "We are contemplating placing . . . an Airline Ground Radio Engineer." Starting salary $385 per month.

These are just a few of the examples of the job offers that come to our office periodically. Some licensed radioman filled each of these jobs; it might have been you!

Ours is the only home study course which supplies FCC-type examinations with all lessons and final tests.

ACT NOW!
Get ALL 3 FREE

**RE'S PROOF FCC LICENSES ARE OFTEN SECURED
A FEW HOURS OF STUDY WITH OUR COACHING
HOME IN SPARE TIME:**

e and Address	License	Lessons
Worthy, ½ Wilshire St., Bakersfield, Cal...........	2nd Phone	16
ford E. Vogt, 1016, Dania, Fla.........................	1st Phone	20
cis X. Foerch, eucler Pl., Bergenfield, N. J................	1st Phone	38
gt. Ben H. Davis, North Roosevelt, Lebanon, Ill..............	1st Phone	28
ert Schoell, West 11th St., Escondido, Cal.............	2nd Phone	23

CARL E. SMITH, E.E. Consulting Engineer, President

EVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-54, 4900 Euclid Bldg., Cleveland 3, Ohio

Your FCC ticket is Recognized in All Radio Fields as Proof of Your Technical Ability.

SAMPLE FCC TYPE EXAM
MONEY MAKING FCC LICENSE INFORMATION
FCC

MAIL COUPON NOW!

Cleveland Institute of Radio Electronics
Desk RN-54—4900 Euclid Bldg., Cleveland 3, Ohio
(Address to Desk No. to avoid delay)

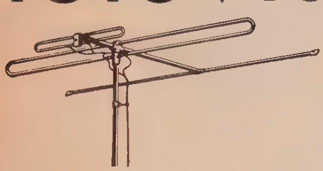
B I want to know how I can get my FCC Ticket in a minimum of time. Send me your FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License), as well as a sample FCC-type exam and the amazing new booklet, "Money-Making FCC License information."

Be sure to tell me about your Television Engineering Course.

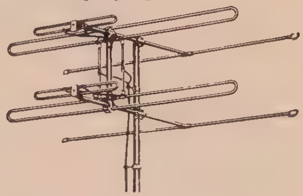
Name ....
Address ....
City.............................. Zone...... State................

Paste on 2 cent postcard or send air mail.

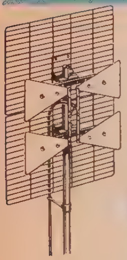
UHF OR VHF television...



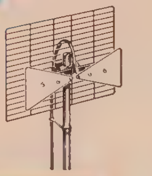
INLINE *Antenna for maximum broadband* VHF *gain over all channels.*



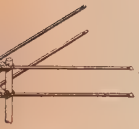
Stacked INLINE VHF *Antenna for fringe signal areas.*



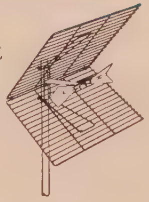
Two BO-TYs *stacked for increased gain and reduced vertical response.*



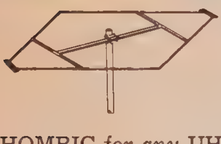
BO-TY *Antenna for all-channel* UHF *reception.*



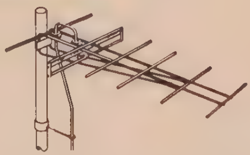
STACKED-V *for* VHF, UHF, *or* VHF-UHF *reception.*



CORNER REFLECTOR *for increased gain over* UHF *channels.*



RHOMBIC *for any* UHF *channels where narrow lobe and high gains are needed.*



YAGI *for maximum gain over specific* UHF *channels.*

For the finest picture your set can produce use a Quality AMPHENOL Antenna best suited to the problems of your location. Consult your AMPHENOL Distributor or Dealer about the specific problems of your particular location.

AMPHENOL

AMERICAN PHENOLIC CORPORATION

chicago 50, illinois

tremely complex and require very critical adjustment There are a dozen interdependent adjustments necessar to bring the three colors into registration. That mak thousands of combinations of adjustments possible, on one of which is correct."

Criticizing the over-zealous probes of Congress, the Mi western setmaker declared: "Scientific progress cannot produced or hastened by either Congressional mandate wishful thinking . . . The one sure way to kill color wou be to release it before it is technically ready for everyda trouble-free service in the home. I fervently hope that t industry will not make that mistake."

Another pessimistic view was offered by Dr. Allen B. D Mont, during a stockholders' meeting. Discussing colo he reported that it would be a long time before a com mercially practical system would be approved. The eng neers of his company, he added, were still not satisfied th the NTSC system was right for the public. The cost the picture tube was still too high, he warned, and t system too complex. In his opinion, 3-D TV offered mo immediate possibilities than color, and at more attracti prices.

Some of the rather dim comments stemmed from rece field tests during which representative color receivers we checked. During one such study of over a dozen sets, on one provided satisfactory results. Most models suffer from color drift, lack of resolution and brightness, a subject matter was only a fixed slide, showing a close of a girl, transmitted over a closed circuit, as well *via* air.

The unsatisfactory results have not quelled the intere of NTSC members who are certain that all of the pro lems will be ironed out and practicable models will e ist soon. Continuing tests are being held, they said, a daily substantial progress is being recorded. When t system is submitted to the Commission for approval t summer, it was noted, most of bugs will have been elim nated from basic designs, and refinements will then be t order of the day.

LOS ANGELES, playing host to the annual convention the National Association of Radio-Television Broadcaste also welcomed five members of the Commission, w traveled three thousand miles to address the group. In t contingent were the new chairman, Rosel Herschel Hy ex-Chairman Paul A. Walker, and Commissioners Geor E. Sterling, Robert T. Bartley, and Frieda Hennock.

In his first public appearance as the FCC's headma Hyde told NARTB members that the Commission certa ly will consider compatible color, when the proposal is su mitted, but such consideration will not be rushed. T problem will be taken up in . . . "regular order, in orderly way, and of course in an objective manner." viewed the establishment or modification of standards a serious business; unless exhaustive field testing proves t practical feasibility of a system, he added, the Commissi cannot consider a change or the issuance of completely n standards.

The first comprehensive report on the Conelrad plan, signed to avert homing of enemy bombers on broadcast f quencies, was presented by Commissioner Sterling, w noted that over 1000 stations have joined the *C* plan. hoped that more would become *C* members, because . "More stations mean greater navigational deception a assure wider dissemination of information to the pub Under the *C* plan, all stations, AM, FM, and TV, must ha radio equipment to receive the radio alert message wh broadcast from key stations; such gear includes a moni receiver tuned to the key station in any given area. present, *C* members participate in tests during expe mental hours late at night using the special 640 and 12 kc. cluster-sequential type of intermittent transmissi Some time in the future, Sterling said, he hoped that might be possible to conduct a drill, which would invo direct public participation during regular broadc hours. Such a drill, he pointed out, would have a . "tremendous impact on industry and public." Howev he warned that the cost would be high, probably $3-m lion an hour.

(*Continued on page* 89)

THE DAGE INDUSTRIAL TV CAMERA

By **HAROLD E. ENNES**
Staff Eng., Indianapolis Broad., Inc.

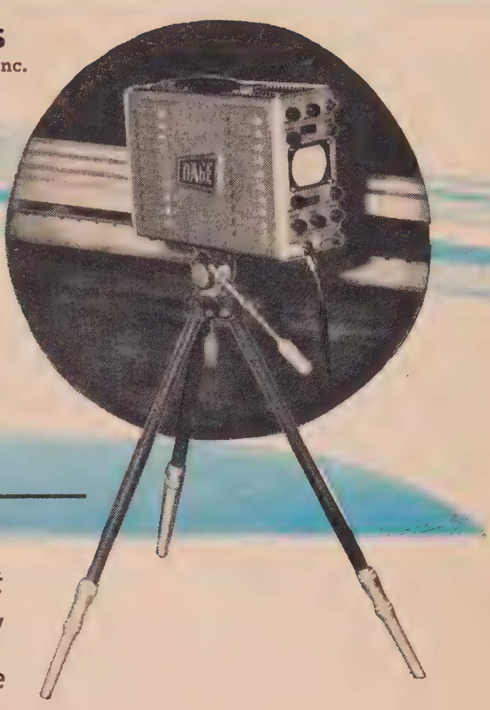


Fig. 1. One application for the Dage camera is the unattended monitoring of a machining operation. Picture can be observed on a standard TV receiver.

'ts compact size, well-designed circuit, and the fact :hat it can be used with an unmodified, standard TV receiver has captured industry-wide attention. Here :s data on how it is built and how it can be used.

THE inevitable expansion in use of electronic devices in industry is opening another doorway to opportunity. The new field of industrial ›r general "closed-circuit" television systems is on the verge of vast naional enlargement, comparable only o the billions soon to be circulating n TV broadcast transmitters and receivers. The application of electronic 'eyes" provides unlimited extension to he arms of industry, science, reearch, education, and business. A arge share of the responsibility for proper servicing and maintenance of uch systems will be charged to the ndependent television service inlustry.

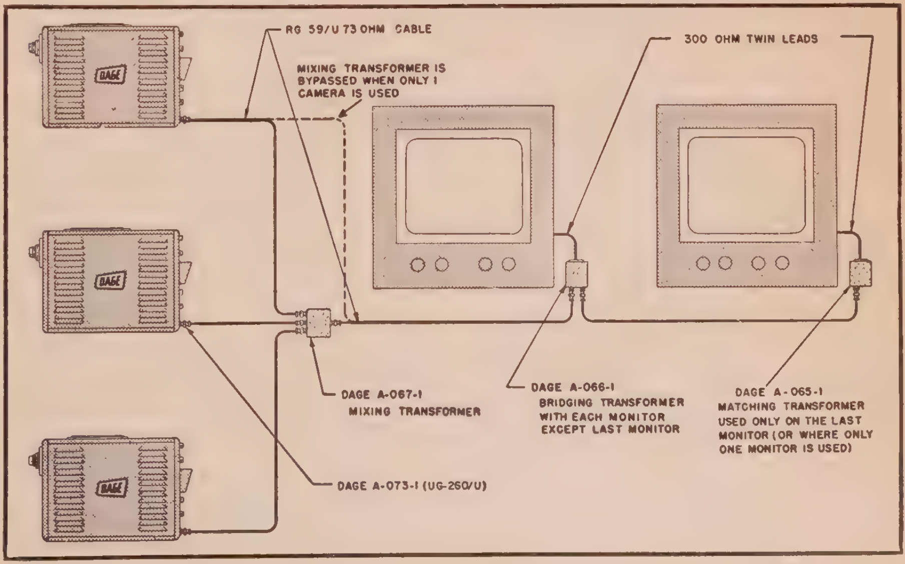
A recent development in this field s already resulting in the national nterest needed to spark large scale .ctivity in closed circuit TV systems. 'his development is the *Dage* ITV 'amera (manufactured by *Dage Electronics Corp.,* Beech Grove, Indi-.na) technically described in this aricle. The low price and relative implicity of setup and use are facors contributing to an assured broad .tilization.

Fig. 1 shows the *Dage* camera in ınattended operation allowing remote bservation of functions. In the simlest installation, the a.c. cord is lugged into a 117-volt outlet and a ingle interconnecting 73-ohm cable is un from the camera output to the ntenna terminals of any standard 'V receiver. A simple matching transormer is used for 300-ohm input receivers. The picture from the camera is received on one of the television channels (2 through 6) and is selected and tuned in exactly the same way as a standard broadcast station is tuned. Any number of cameras at different locations can be fed into a single receiver, or a number of receivers at different viewing points can be connected to one or more cameras, as shown in Fig. 2. No modification of any kind is necessary in the receiver, making practical the purchase of inexpensive receivers where desirable.

The camera is a completely self-contained transmission system with only 17 tubes including the Vidicon pickup tube, video amplifiers, sync generator, regulated power supply, kinescope camera monitor, and composite modulated r.f. output. The unit is 9⅜" high, 4⅝" wide, 14" in length, and weighs only 18 pounds.

The miniature size of the *Dage* camera is achieved, in part, by use of

Fig. 2. How a number of cameras at different locations can be fed into a single receiver or how a number of receivers at different viewing points can be connected to one or more cameras. No receiver modifications are required in this TV setup.


RG 59/U 73 OHM CABLE
MIXING TRANSFORMER IS BYPASSED WHEN ONLY 1 CAMERA IS USED
300 OHM TWIN LEADS
DAGE
DAGE
DAGE
DAGE A-067-1 MIXING TRANSFORMER
DAGE A-066-1 BRIDGING TRANSFORMER WITH EACH MONITOR EXCEPT LAST MONITOR
DAGE A-065-1 MATCHING TRANSFORMER USED ONLY ON THE LAST MONITOR (OR WHERE ONLY ONE MONITOR IS USED)
DAGE A-073-1 (UG-260/U)

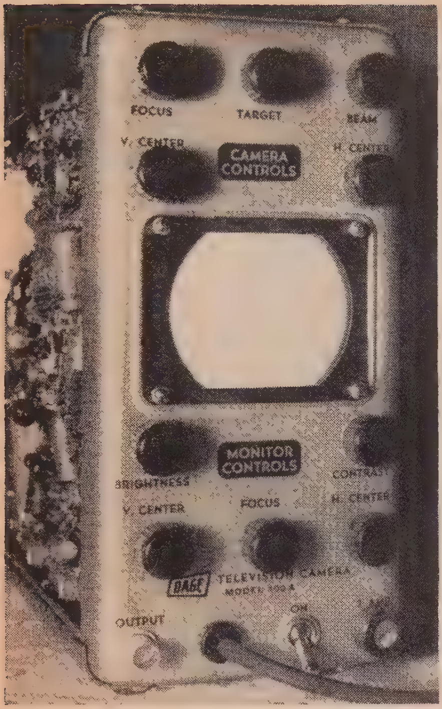


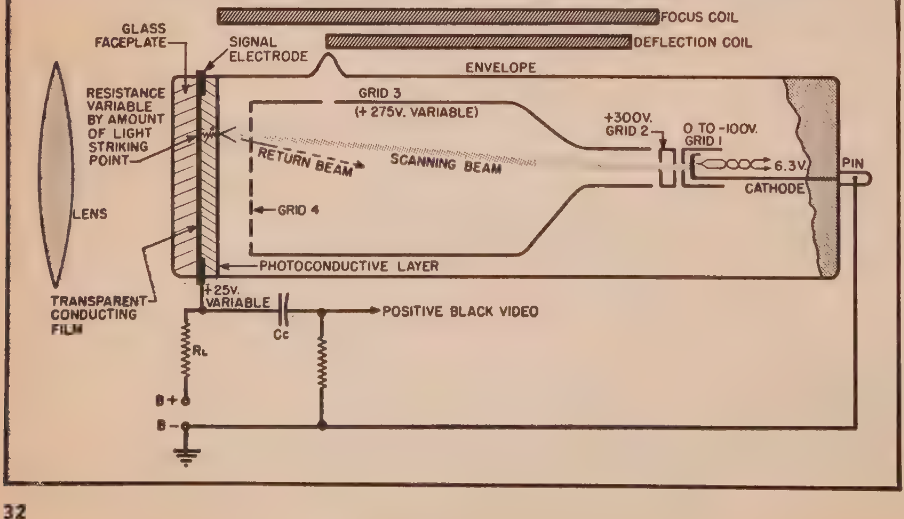
Fig. 3. Rear panel view of the Dage camera showing various camera and monitor controls.

the newly-developed *RCA* Vidicon pickup tube, type 6198. This pickup tube is only 6¼ inches long by 1 inch in diameter. Familiarity with operational characteristics is important to an understanding of camera operation. Since this tube has not been widely publicized in technical details, a very brief review follows of pertinent points. Fig. 4 is an exaggerated "functional" drawing to illustrate basic operation.

The scanning beam is supplied by a conventional electron gun with a 6.3 volt heater used to heat a thermionic cathode placed at ground potential. Four grids are used with the following functions: *Grid #1* (control grid) Picture cut-off value from —45 to —100 volts. *Grid #2* (accelerator grid) Ordinarily operated at a fixed positive voltage in the vicinity of 275 to 300 volts. *Grid #3* (focusing electrode) Current in the external focusing coil provides a uniform magnetic field through which the scanning beam is swept by the deflection coil saw-tooth currents. Grid #3 potential between plus 200 and plus 300 volts provides an electrostatic field in conjunction with the magnetic field to focus the electron beam at the photoconductive target. Current through the external focusing coil is fixed in the *Dage* camera, and grid #3 voltage is made variable to allow optimum electrical focus. *Grid #4* (decelerator electrode) This is a fine mesh screen adjacent to the photoconductive layer and attached to grid #3. This electrode is therefore maintained at the same operating potential as grid 3. The physical configuration provides a uniform field on the beam side of the target so that the beam strikes the photoconductive layer perpendicularly, irrespective of the angle from which approach is made. Decelerating action results from the fact that the signal electrode is operated at a much lower voltage of plus 20 to 30 volts. A low-velocity scanning beam results similar to that in the broadcast type image orthicon; but here the similarity ends.

The light-sensitive element may be visualized as being comprised of two separate elements electrically; (1) a transparent conductive film coating on the inner surface of the glass faceplate, and; (2) a thin layer of photoconductive substance on the scanned side. This is obviously highly exaggerated in the drawing. A metal ring around the front end of the tube serves as the signal lead connection, to which the load resistor is connected in series with the "B plus" supply. The scanning beam is in series with the complete signal circuit. The resistance of the photoconductive layer is dependent upon the amount of light striking it through the lens, being very high under no-light conditions, and less in ratio to the increase in light. One plate of the electrically separate plates is charged to the plus voltage on the signal electrode, while the other plate is charged down to cathode potential by the scanning beam. The remaining beam electrons are turned back in the form of a return beam under the influence of the positive grids, but is not used in the Vidicon.

Fig. 4. "Functional" diagram which illustrates basic operation of the Vidicon tube.



Under no-light conditions when the photoconductive element exhibits the characteristics of an insulator, very little current flows through the complete signal path. What little current does flow is termed the "dark current" which is a limiting factor in maximum signal electrode voltage. When light reaches the tube, the transparent conducting film on the inner surface of the glass faceplate begins conduction by an amount dependent upon the light intensity at that particular point, causing the corresponding point on the gun side to rise slightly toward the plus potential of the target supply. Thus the beam current increases at the points of the positive potential pattern created on the gun side of the target in accordance with the light distribution in the focused image. It is noted that the signal current through the load resistor increases for light portions and decreases for dark portions of the image, resulting in a positive black signal at the grid of the first preamplifier tube.

The scanning area of the Vidicon is only ½" wide by ⅜" in height. A 3" lens therefore is a "telephoto" type lens for a Vidicon tube, covering a field of 10 by 13.3 feet at a distance of 80 feet. A 1" lens is the general purpose type and a ½" lens is used for "wide angle" applications.

The spectral response under incandescent lighting is approximately the same as the human eye. Response may also be obtained in the infrared and ultraviolet regions. Only 50 to 100 foot-candles of incident illumination is required with a ½" or 1" lens (*f*1.5), and a readable picture can be obtained from the *Dage* camera with 10 foot-candles of light.

Camera and Monitor Controls

External controls for the camera and built-in monitor are shown in Fig. 3. Fig. 5 shows the interior layout. The monitor uses a 3" kinescope (3RP1) with P1 phosphor. This serves as an excellent "range finder" for lens and camera adjustments where the monitoring receivers may be out of visual range of the camera setup.

The group of "Camera Controls" perform the following functions:

Focus—Varies voltage on grid 3 (focusing grid) of Vidicon. (See block diagram, Fig. 6). In practice the lens focusing collar is adjusted for proper distance to obtain sharp optical focus, then the "Focus" control is adjusted for maximum resolution of picture detail. A resolving power of 350 lines is possible in this camera.

Target—Adjusts voltage on photoconductive target of Vidicon. See Fig. 6. Variation of this control affects the quality of the picture in relation to amount of light on the transmitted scene. For a given operating voltage the sensitivity and dark current both tend to gradually change throughout the life of the tube, making mandatory an adjustable voltage to compensate for these changes. Under low light level conditions, the control may be operated toward full clockwise position (maximum voltage) for increased sensitivity. There is, however, a limiting value of target voltage beyond which the non-uniformity of the dark-current background in the picture reaches intolerable proportions. With sufficient light, the picture is improved by reducing the "Target" control setting.

Beam—Adjusts the negative potential of grid 1 (control grid) in the Vidicon. At a fully counterclockwise position (maximum negative voltage) the beam is cut off and no picture appears. As the control is adjusted clockwise, fixing amount of beam current by decreasing negative grid potential, the picture is observed to "wipe clean" with the brightest areas coming in last. The low-lights or dark portions of the scene appear first since the beam is sufficient to resolve the darker (less positive) areas, but insufficient to discharge the brighter portions (more positive) areas. The "Beam" control is left just clockwise of the point where there is enough beam current to resolve all highlights, since further rotation causes loss of resolution by the well-known spreading of an electron beam with too much beam current.

V. Center—A control in the camera vertical output stage V_{10B} which adjusts the magnitude of d.c. in the vertical deflection coil of the Vidicon. This centers the sweep vertically.

H. Center—A control in the camera horizontal output stage V_{12} which adjusts the amount of d.c. in the horizontal deflection coil for the Vidicon. This centers the sweep horizontally.

The camera "Monitor Controls" are self-explanatory with the exception of the "Contrast" control. This control is actually in the cathode of the second video amplifier stage (V_3) and determines the gain of the video amplifier. As such, it affects the contrast of the picture on the viewing receivers as well as the camera monitor. The gain is variable over a range of approximately 10 db. It is often found desirable in practice to set this control about ¼ to ½ open, and vary the contrast over a fine range by the "Target" control described previously. The "Contrast" control, however, provides a more flexible adjustment for meeting the requirements of different viewing receivers.

Video Amplifiers

As indicated in Fig. 6, four 6CB6 video amplifier stages are employed. Essentially uniform response to over 4 mc. is achieved by the use of combination series-shunt peaking circuits in all stages except the "high-peaker" stage V_3. Input stages between the pickup tube and first video amplifier are notably lacking in high-frequency response due to the inherently large shunt capacitances of such circuits. It is the purpose of the "high-peaker," V_3, in the *Dage* camera to compensate for this deficiency by a deliberate boosting of the high-end of the response curve in this stage. This is accomplished by using a very low value of plate load resistor (120 ohms) in series with an inductance. This arrangement provides an essentially inductive load at the higher frequencies in the desired passband, resulting in the necessary high-frequency boost for a flat over-all response curve.

The "Contrast" control mentioned before is a 2500 ohm variable potentiometer in the cathode of this stage, allowing a 10 db variation of stage gain. This control may actually be left in the minimum gain position and still provide sufficient contrast in most applications, with judicious setting of "Target" and "Beam" controls.

As noted from Fig. 6, the Vidicon grid #2 (accelerator grid) pin 5, is operated at a fixed plus potential of approximately 275 volts from the low voltage filter supply. The "Focus" control R_3, resistor R_2 and "Target" control R_1 form a voltage divider from pin 5 to ground. This provides the proper range of voltage adjustments for "Focus" and "Target" electrodes. The signal current variations through coupling resistor R_7 provide the signal voltage for the following first video amplifier stage through coupling con-

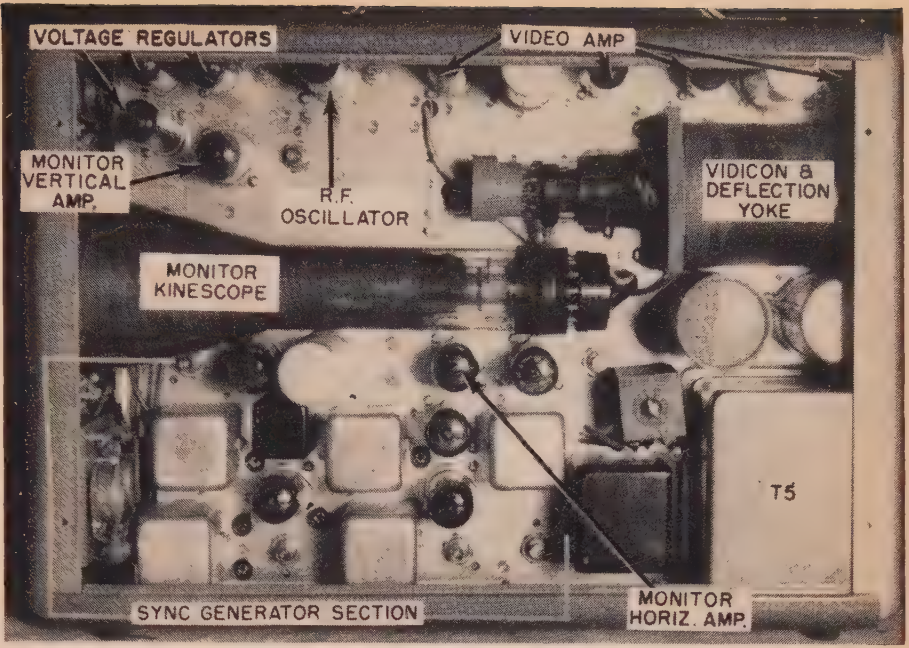
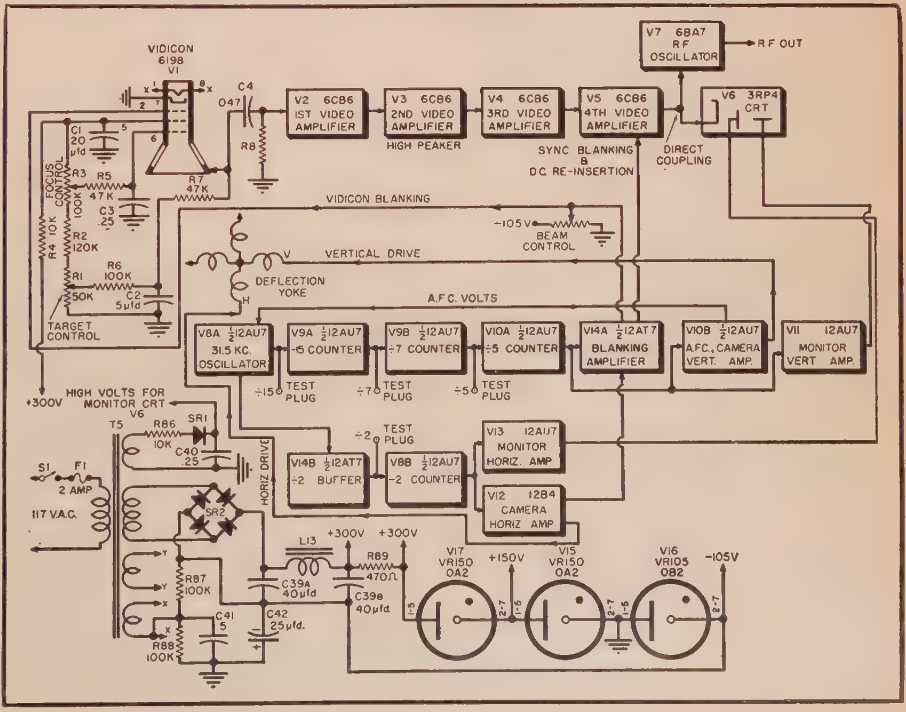


Fig. 5. Internal view of camera showing layout of chassis on the tube side of unit.

Fig. 6. Block diagram of the camera. An RCA type 6198 Vidicon pickup tube is employed.



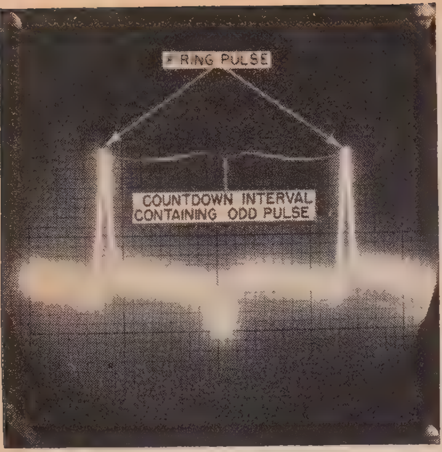


Fig. 7. "Divided by 2" counter pulses on scope when connected to "Test Plug ÷ 2." Every second pulse triggers ÷ 2 oscillator.

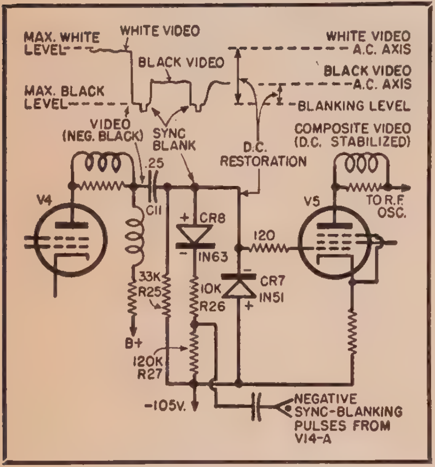


Fig. 8. The sync blanking and d.c. insertion circuit used in the Dage TV camera.

denser C_4. Condensers C_1, C_2, and C_3 provide adequate bypass of hum and stray field pickup and isolation from the common impedance of the power supply.

Blanking and Insertion

An important factor in the excellent results obtainable from this TV system is the simplified but effective method of injecting the sync-blanking pulses and re-inserting the d.c. component. The importance of proper d.c. insertion is emphasized by the fact that small shifts in black level have a noticeably adverse effect on dark tone rendition in the image. Sync-blanking insertion and d.c. re-insertion are combined in this camera by the use of two germanium crystal diodes in the circuit illustrated in Fig. 8. CR_8 serves to inject sync-blanking pulses and CR_7 inserts the d.c. component necessary to hold the blanking at a predetermined level irrespective of whether the video signal is in white or black regions at the moment of injection.

The picture signal is black negative polarity at the output of V_4, coupled to the grid of V_5 through C_{11} and grid return R_{25}. This return is made to a negative potential of 105 volts. During the active line scan (no sync-blanking pulses received) the V_5 grid is biased through R_{25}. At the end of each line, large negative sync-blanking pulses at 15,750 pps are injected at the junction of R_{26}-R_{27}. At the end of each field, the longer duration 60 pps sync-blanking pulses are injected. During these large negative excursions, CR_8 is driven into conduction inserting the pulses on the video signal.

Insofar as these control pulses are concerned, CR_8 and CR_7 are in series. The larger negative potential existing on the grid during the pulse injection drives CR_7 into conduction at the same instant. Thus the sync-blanking is continually referred to a constant bias reference, and the equilibrium charge on coupling condenser C_{11} appears as d.c. across diode CR_7 which holds the grid of V_5 at a constant level compared to blanking pulse amplitude. To this d.c. component is added the video a.c. component and constant background brightness relative to scenic content is restored. The direction of bias change is such that it compensates for the shift in the composite video waveform, as illustrated at the top of Fig. 8.

R.F. Oscillator Output

The composite, d.c. stabilized output of V_5 is black positive and is conductively coupled to the r.f. oscillator V_7 to retain the d.c. component. This stage is a miniature 6BA7 pentagrid converter used in a modified Hartley oscillator circuit to supply a double-sideband, amplitude-modulated video signal. It is tuned to any of the standard TV channels (2 through 6) by means of a slug adjustment in the Hartley coil, and provides a highly stabilized output.

Although the plate of V_5 is conductively coupled to the third grid of the oscillator V_7, this grid is returned to a point of negative potential and the effective voltage is about plus 5 volts. Grids 2 and 4 and the plate of V_7 operate at the relatively low positive potential of 82 volts.

Since the polarity of the applied composite video is positive, the amplitude of the r.f. carrier increases in the black sync-blanking region, and decreases with picture brightness, resulting in the standard negative modulation. Some beneficial limiting action occurs in V_7 on sync-blank peaks since the added positive potential on grid 3 and relatively low plate voltage causes the tube to be driven into the beginning of plate current saturation. This aids in holding the sync levels at the same height for successive peaks for efficient receiver sync control.

The Sync Generator

Both line frequency pulses (15,750 pps) and field pulses (60 pps) are derived from a common master oscillator operating at 31,500 cycles. This permits effective use of a line-lock stabilizing circuit which compares favorably in stability characteristics with commercial type broadcast equipment.

Blocking oscillators are used for the master oscillator and all divider circuits. The blocking type has an inherently greater stability than multivibrators when required to obtain greater frequency division than 2. The vertical sync-blanking is derived from the 15, 7, 5 chain of dividers. (The term "sync-blanking" is used since one pulse serves both purposes as shown in Figs. 9 and 10). A pulse from the grid side of the master oscillator is fed through a buffer stage to a single ÷2 counter for the horizontal sync-blanking. Equalizing pulses are not used in this system, greatly simplifying the circuit and maintenance requirements. Since the system is a closed circuit and the control pulses fed to the viewing receiver utilize the same driving pulses that scan the Vidicon pickup tube, ordinary transmission vagaries are precluded and no difficulty is experienced in the field with pairing of lines in a properly adjusted receiver.

The sync generator adjustment is straightforward and simple. The initial adjustment of the 31,500 cycle master oscillator is made by connecting one lead of a pair of headphones in series with a germanium diode to "Test Plug ÷2," and the other lead to

(*Continued on page* 125)

Fig. 9. Rectified composite signal at the camera output (line frequency). See text.

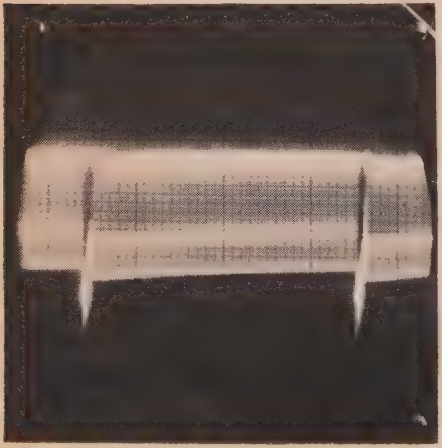
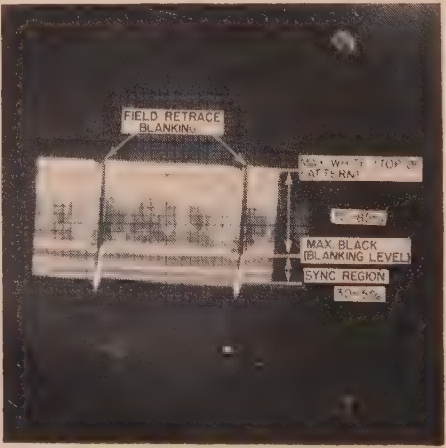


Fig. 10. The rectified composite signal at the camera output (field frequency).

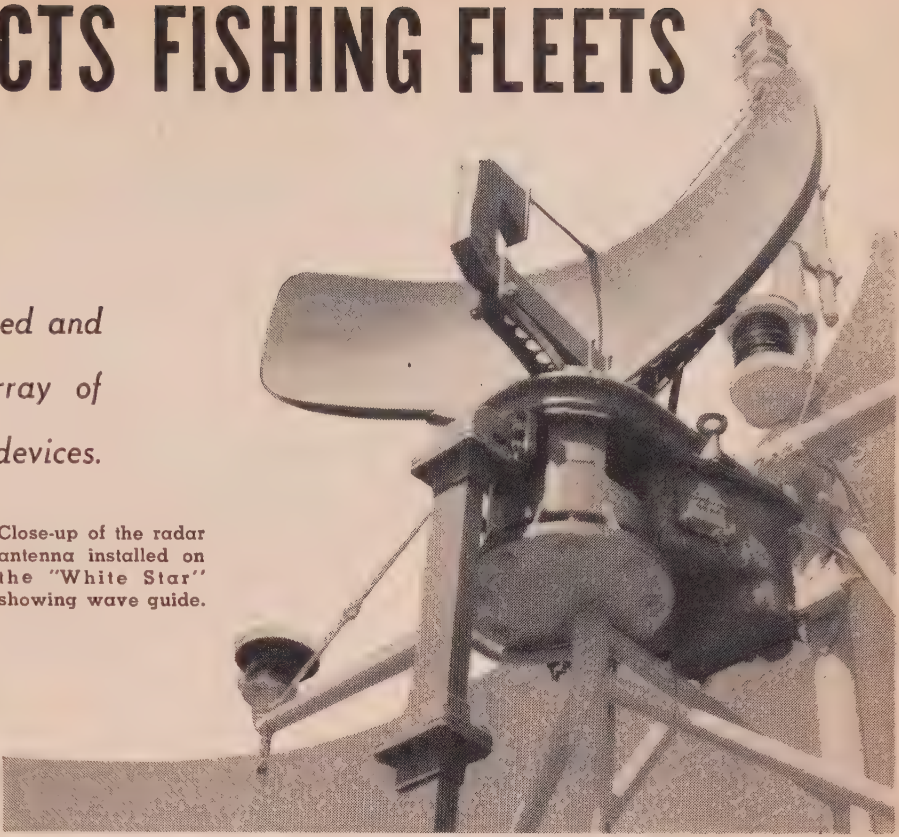


ADAR PROTECTS FISHING FLEETS

By

RAY FRANK, W9JU

ommercial fishing fleets are aided and otected by an impressive array of odern electronic indicating devices.



Close-up of the radar antenna installed on the "White Star" showing wave guide.

NE OF THE hazards of small-boat navigation has always been the inability of the pilot to determine exact position or detect dangerous stacles in fog or darkness.

Direction finders are very useful in termining location, but do require ntinuous plotting on charts to fix e exact position at any given time. vigation by readings on the sun or rs also has this same limitation.

Many fatal accidents could be pre- nted if all boats were equipped with e "seeing eye" known as radar, as s device has none of the aforemen- ned limitations. At any time the rrounding area is under surveil- nce, with the result that the danger collision with unseen objects is eatly reduced.

Radar has been in widespread use military purposes for several years d many special types have been de- loped for specific applications.

The unit pictured on the cover and the accompanying photographs is pical of small-boat installations. The dar unit itself is a *"Ranger Radar"* anufactured by the *Electric Service mpany* of Seattle, Washington. This uipment is installed on the boat *Vhite Star,"* one of the fleet of fish- g boats operated by the *Van Camp nneries* of Terminal Island, Califor- a. This company is the processor of e well-known *"Chicken of the Sea"* and of tuna.

The boat is a regular working craft 113 tons and has an over-all length 104 feet. The boat, which has a uising range of over 2500 miles, is ed for both business and pleasure Gilbert C. Van Camp, Jr.

The radar antenna shown on this onth's cover inset rotates constantly en the unit is in use, affording 360 gree coverage of the surrounding ea. Rotation is at a speed of four volutions-per-minute and, due to the rsistence of the viewing screen, any jects scanned by the beam will re- ain illuminated on the screen until ain scanned.

As the antenna rotates, a picture of e surrounding area is formed on the ewing screen of the receiver. The at always appears in the center of e screen, with surrounding objects appearing as dots or spots in their exact relation to the boat.

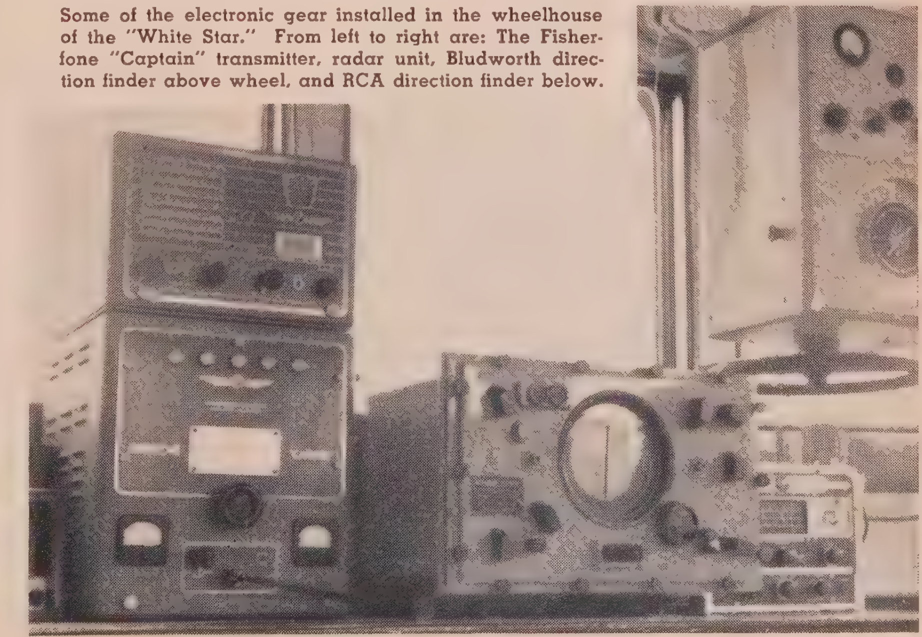
The bezel surrounding the screen is calibrated in degrees so that the relative bearing to the boat may be read directly. The vertical line in the center of the viewing screen may be rotated to allow the operator to determine the exact bearing of any object on the screen. The screen is so positioned that the heading of the boat always appears at the top.

The screen of the unit is calibrated in three ranges. These are 4 miles, 20 miles, and 80 miles. At close quarters such as in harbors, along the coast, or during darkness or fog, the four-mile range is used. When attempting to locate other boats of the fleet, or under clear sailing conditions, either the twenty- or eighty-mile range is used.

The two longer ranges are particularly useful when one of the boats of the fleet locates a school of fish. Other radar-equipped boats of the fleet can readily locate the lucky boat if the approximate direction is known. Thus, the entire fleet can quickly converge on the spot, greatly increasing the catch.

The peak power developed by the radar unit is great enough to allow

(*Continued on page* 123)



Some of the electronic gear installed in the wheelhouse of the "White Star." From left to right are: The Fisherfone "Captain" transmitter, radar unit, Bludworth direction finder above wheel, and RCA direction finder below.

COAXIAL SPEAKER DIVIDING NETWORKS

By **LLOYD C. GOSS**

The selection of a suitable dividing network depends on several factors, including both price and quality desired

THE audio enthusiast who wants a high-quality, high-fidelity audio system invariably uses coaxial speaker arrangements. These arrangements consist of two speakers, one for high notes (the tweeter) and the other for reproducing the lows (the woofer). A necessary evil for such a system is the dividing network.

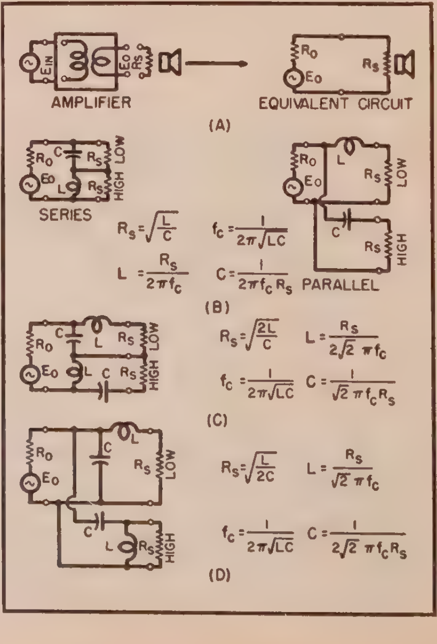
Frequency-dividing networks channel the high frequencies to the tweeter and the low frequencies to the woofer. The frequency at which the network divides between lows and highs is called the crossover frequency. If we consider a network with a crossover frequency of 1000 cps connected to an amplifier producing a 500 cps and a 2000 cps signal, the network directs the 500 cps signal to the woofer and the 2000 cps signal to the tweeter.

Stopbands and passbands also enter into filter terminology. The low frequency stopbands and passbands occur respectively above and below the crossover frequency. High frequency stopbands and passbands are below and above the crossover frequency.

Attenuation, the ratio of power delivered to a load without the network (P_1) to the power delivered to the load with the network, (P_2) is measured in db (decibels) according to: $db = 10 \log_{10} (P_1/P_2)$. We want zero attenuation in the passbands and high attenuation in the stopbands. Typical attenuation curves displayed in Fig. 3 illustrate how the networks shift the amplifier output from one speaker to the other at the cut-off frequency.

Usually the impedance of the high-frequency and low-frequency speakers are the same. This leads to the problem of matching both speakers to the output impedance of the audio amplifier. The amplifier can be resolved into an equivalent generator and series impedance with Thevenin's Theorem. Fig. 1A illustrates this transformation. The generator has an e.m.f. of E_o volts equal to the open circuit voltage of the amplifier, while R_o equals the amplifier output impedance. Now, the maximum power transfer theorem states that max mum power is delivered to a loa from a generator when the impedanc of the load equals the impedance c the generator. Applied here, the im pedance of the speaker must matc that of the amplifier at all frequer cies. Networks which do this consis of pure reactances. The characteristi impedance of such a network is th impedance seen looking into the ne work when the network is terminate by its characteristic impedance.

Fig. 1. (A) Amplifier and its equivalent circuit as a generator and output impedance. (B) Series and parallel quarter-section constant resistance networks. (C) Series half-section network, and (D) Parallel half-section network. Calculations are also given.



AMPLIFIER
EQUIVALENT CIRCUIT
(A)
R_o
E_o
R_s
SERIES
HIGH
LOW
$R_s=\sqrt{\frac{L}{C}}$
$f_c=\frac{1}{2\pi\sqrt{LC}}$
$L=\frac{R_s}{2\pi f_c}$
$C=\frac{1}{2\pi f_c R_s}$
PARALLEL
(B)
$R_s=\sqrt{\frac{2L}{C}}$
$L=\frac{R_s}{2\sqrt{2}\,\pi f_c}$
$f_c=\frac{1}{2\pi\sqrt{LC}}$
$C=\frac{1}{\sqrt{2}\,\pi f_c R_s}$
(C)
$R_s=\sqrt{\frac{L}{2C}}$
$L=\frac{R_s}{\sqrt{2}\,\pi f_c}$
$f_c=\frac{1}{2\pi\sqrt{LC}}$
$C=\frac{1}{2\sqrt{2}\,\pi f_c R_s}$
(D)

Frequency dividing networks of thi type divide into two groups: (1) co stant resistance networks and (2 filter networks. The constant resis ance network actually has a charac teristic impedance independent of fre quency while the characteristic imped ance of the filter network remain constant only over a portion of th passband.

Constant Resistance Networks

The constant resistance networ derives its name from the fact tha when terminated by constant resist ance speakers, it presents a constan resistance to the amplifier at all fre quencies. These networks also divid into two groups: (1) quarter-sectio networks, and (2) half-section ne works. Schematics of these network appear in Figs. 1B, 1C, and 1D.

1 *Quarter-section Networks:* Sche matics of the quarter-section network appear in Fig. 1B. The parallel an series networks have identical value of circuit elements and attenuatio characteristics. The crossover frequer cy occurs at series resonance or whe the reactance of the inductor equal that of the condenser. Equating thes values gives a crossover frequency c $f_c = 1/2\pi\sqrt{LC}$. These networks hav the unique feature of presentin the amplifier with a constant resis ance ($R_s = \sqrt{L/C}$) over the audi range. This advantage enables th output transformer to deliver co stant power to the speaker system a all frequencies.

The attenuation curves of Fig. show how the network shifts the an plifier output from one speaker to th other at the crossover frequency. figure of merit for attenuation in d viding networks is the attenuation i db-per-octave relative to the cros over frequency. This network has a attenuation of 6 db/octave. The equa tions for calculating L and C also a pear with the circuit diagram in Fi 1B. It should be noted that in all th formulas presented in this article, is in henrys, C is in farads, and f in cps.

2 *Half-section Networks:* Sch matics of the series and parallel hal section networks appear in Figs. 1 and 1D respectively. These networ also present a constant resistance the amplifier over the audio rang Their attenuation characteristics a superior to the quarter-section type seen by the curve of Fig. 3. This ci cuit has a figure of merit of 12 db/o tave. The improved attenuation wa

ected since the half-section used elements instead of two.

gain, the crossover frequency oc- s at series resonance; $f_c = 1/2\pi\sqrt{LC}$. ween the series and parallel net- ks, a factor of two exist in values he circuit elements. In the series work, we find the reactances half hose in the parallel network. The ations for calculating the circuit nents appear with the diagram in s. 1C and 1D. Selection of either series or parallel network depends the crossover frequency desired, circuit elements on hand, or the e of condensers and inductors.

Filter Networks

'ilter networks differ from constant stance networks in their imped- e characteristics. A filter network primarily designed to operate be- en impedances which match the racteristic impedance of the filter. . 4 shows how the characteristic edance (Z_o) of symmetrical "pi" "T" circuits vary with frequency. en terminated at each end by the racteristic impedance, these filters e zero attenuation in the passband high attenuation in the stopband. ler these ideal conditions, the na- e of the characteristic impedance ermines the attenuation. In the sband the characteristic impedance esistive while at the crossover fre- ncy it becomes reactive. Since a ctive impedance cannot absorb ver ($P = I^2R$), the attenuation in- ases at a rapid rate outside the sband.

ince we cannot match the termi- ing impedances ideally with trans- mers and speakers, impedance mis- tch losses occur. These losses cause enuation in the passband and re- d attenuation in the stopband. The ulting attenuation curves of Fig. how that the attenuation proper- s are superior to those of the con- nt resistance filter.

'he cut-off frequencies no longer occur at the natural series resonance frequency of the reactive elements. For a high pass filter $f_c = 1/4\pi\sqrt{LC}$, and for a low pass filter $f_c = 1/\pi\sqrt{LC}$. These frequencies occur when the characteristic impedance changes from resistive to reactive.

Formulas for calculation of the circuit elements appear with the circuit diagram of each filter. Again, a choice between a "T" or "pi" network rests on individual preferences and economic considerations. See Fig. 2.

Design Considerations

Three factors affect the economic considerations of designing a dividing network: (1) crossover frequency, (2) attenuation desired, and (3) quality of parts.

A high crossover frequency lowers the size of the inductors and condensers since the crossover frequency occurs in the denominator of every circuit element equation. Selection of the crossover frequency should stem from the speakers used. Usually 400 cps to 500 cps give optimum performance, but this low range demands large condensers and inductors.

The crossover frequency also has an effect on the quality of parts. The networks were designed assuming the condensers and inductors to be pure reactances. At the crossover frequency, inductors should have a Q of 20 or better to preserve their attenuation characteristics. Since $Q = 2\pi fL/R_L$ doubling the crossover frequency doubles the *"Q"* of the coil. Also air-core coils must be used because saturation of an iron core changes the inductance with variations in coil current. The resistance due to dielectric losses in condensers can be neglected, but it should be kept in mind that only paper and oil-filled condensers can be used. The electrolytic types are not suitable.

The attenuation curves of Fig. 3 show that for every two elements we get 6 db/octave attenuation. The cost then varies directly as the attenuation desired. The constant resistance networks have the advantage of reflecting the speaker resistance to the amplifier at all frequencies. In most cases though, the impedance of the speaker varies with frequency. This is especially true in the low-frequency unit where impedance measurements show an increase of two to three times the normal value, around 100 cps.

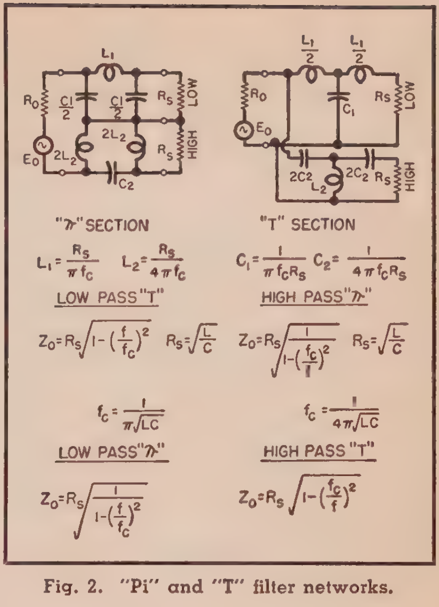


Fig. 2. "Pi" and "T" filter networks.

The greater attenuation of a "pi" or "T" filter has the disadvantage of an impedance mismatch in the crossover frequency region. In actual circuits this mismatch does not seem to affect the listening quality.

The selection of one of the three basic networks depends upon your desire for quality and your pocketbook.

BIBLIOGRAPHY

Briggs, G. A.: "Loud Speakers," Yorkshire, Wharfedale Wireless, 1948.

Hillard, John K.: "Loud Speaker Dividing Networks," Electronics, January 1941.

Jackson, L. C.: "Wave Filters," Third Edition, London, Methuen & Company, Ltd., 1950.

Ryder, John D.: "Networks, Lines, and Fields," Prentice-Hall, Inc. 1949.

—30—

;. 3. Attenuation curves for quarter-, half-, and filter-sections.

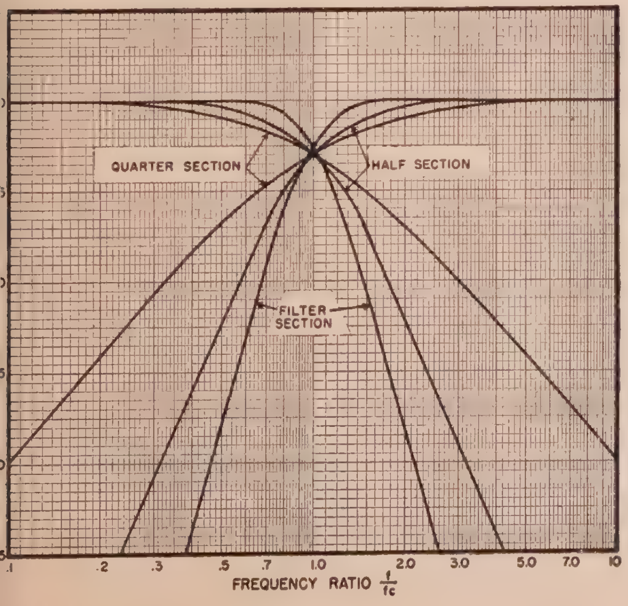
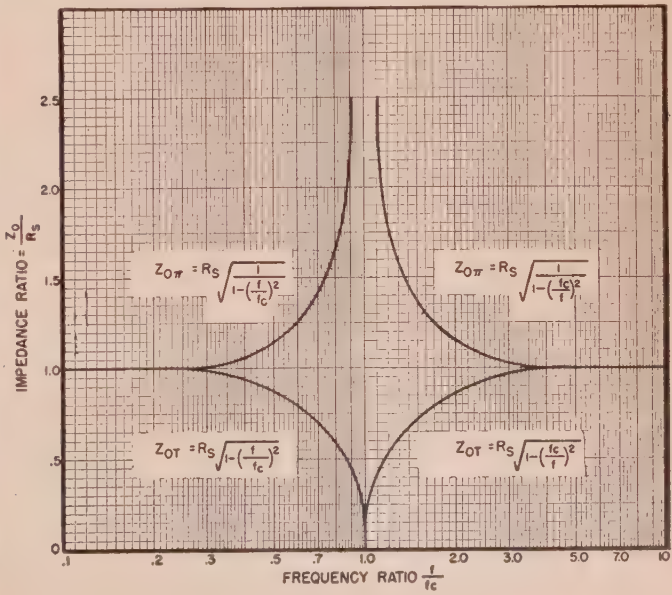


Fig. 4. Variation of characteristic impedance of "pi" and "T" nets.



TV INTERFERENCE SIGNALS

FROM (mc.)	TO (mc.)	SERVICE	HARMONIC	ENTERS AT	REMEDY
.535	1.605	BC	—	2nd. det., video, a.c.	Shielding, line filter
1.605	1.8	Aircraft, police	—	2nd det., video, a.c.	Shielding, line filter
1.8	2	Amateur, loran	—	2nd det., video, a.c.	Shielding, line filter
2.065	2.105	Maritime	10	I.F.	High-pass filter, shielding
3.2	3.4	Short-wave	7-8 —	I.F. 2nd det., video, a.c.	High-pass filter Shielding, line filter
3.5	4	Amateur	6-7 —	I.F. 2nd det., video, a.c.	High-pass filter Shielding, line filter
4.75	4.85	Short-wave	5	I.F.	High-pass filter, i.f. shields
7	7.3	Amateur	3	I.F., antenna	High-pass filter, i.f. shields
11	11.975	Short-wave	2	I.F., antenna	High-pass filter, i.f. shields
14	14.35	Amateur	3 4	I.F., 41 mc., antenna Antenna, Channel 2	High-pass filter, i.f. shields Modify antenna and lead-in
15.1	15.45	Short-wave	3	I.F., 41 mc., antenna	High-pass filter, i.f. shields
17.7	17.9	Short-wave	3	Antenna, Channel 2	Modify antenna and lead-in
21	21.45	Amateur	—	I.F., antenna, a.c.	High-pass filter, shielding, line filter
21.45	21.75	Short-wave	—	I.F., antenna	High-pass filter, i.f. shields
21.85	22	Aircraft	—	Antenna	High-pass filter
22	22.72	Maritime	—	I.F. (rarely), antenna	High-pass filter
23.2	23.33	Aircraft	—	Antenna	High-pass filter
25.6	26.1	Short-wave	—	I.F., antenna	High-pass filter, i.f. shields
27.185	27.455	Industrial, medical	2 —	Antenna, Channel 2 I.F., antenna, a.c.	Modify antenna High-pass filter, shielding, line filter
28	29.7	Amateur	2	Antenna, Channel 2	Modify antenna and lead-in
29.7	42	Gov't, fire, petroleum, etc.	2 —	Antenna, Channels 2-6 I.F., 41 mc.	Modify antenna and lead-in High-pass filter, shielding
42	44	Police, highway	—	I.F., 41 mc., antenna, a.c.	High-pass filter, shielding, line filter
44	50	Short-wave	—	I.F., 41 mc., antenna, a.c.	High-pass filter, shielding, line filter
54	72	TV	Osc. radiation	Antenna	Modify antenna and lead-in, re-align and shield offender
76	88	TV	Osc. radiation	Antenna	Modify antenna and lead-in, re-align and shield offender
88	108	FM	2 Image	Antenna, Channels 7-13 Antenna, Channels 2-3	Modify antenna and lead-in Wave trap
108	132	Aircraft	Image	Antenna, Channels 3-6	Wave trap
148	174	Gov't, railroad, police	Image 3	Antenna, Channels 7-13* Antenna, Channels 14-22	Wave trap Modify antenna and lead-in
174	216	TV	Osc. radiation	Antenna	Modify antenna and lead-in, re-align and shield offender
216	220	Gov't	3	Antenna, Channels 43-46	Modify antenna and lead-in
220	225	Amateur	Image 3	Antenna, Channel 7 Antenna, Channels 46-49	Wave trap Modify antenna and lead in
225	470	Aircraft, military	Image 2	Antenna, Channels 14-28* Antenna, Channels 14-83	 Modify antenna and lead-in
470	890	U.h.f. TV	Osc. radiation	Antenna, Channels 14-83	Modify antenna and lead-in, re-align and shield offender

*Where oscillator operates below incoming signal.

By

ROBERT B. GARY

A summary of possible TV interference sources and how to eliminate causes.

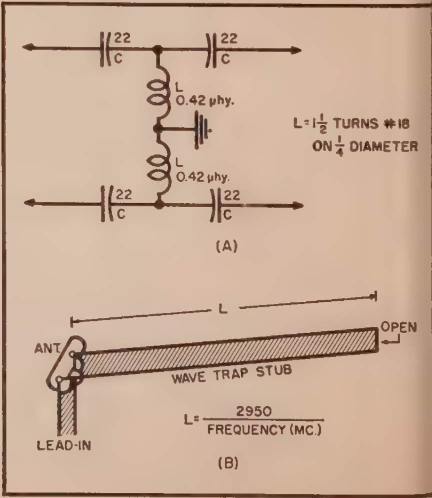
INTERFERENCE signals may ente the TV receiver through one o several of the following points antenna, lead-in, i.f. section, 2nd detector, video amplifier, or a.c. line The frequency and strength of the interference will determine, to a grea extent, where it appears. Signals much higher than the i.f. frequency will usually enter through the r.f. and antenna section while broadcast radio interference is likely to be picked up in the 2nd detector and video amplifier.

The measures taken to eliminate any particular interference will depend on where the signal enters. I interference comes at several points several different steps are required Basically the interference is remove either by shielding or blocking it with a resonant circuit. Shielding is necessary where certain parts act as antennas, sometimes the entire T chassis. Copper screening is a very effective shield, provided it is properly grounded and traps are used on al leads going through the shield.

The a.c. filters for TV sets are standard items and are quite effective if located close to the TV chassis. Filters for the antenna terminals come in a great variety of types and their specifications depend on the type o interference. Most widely used are high-pass filters which cut out all signals below 54 mc. Special FM interference filters and other narrow-ban

(*Continued on page* 88)

Fig. 1. Design data for constructing a high-pass 300-ohm filter and a 300-ohm tuned stub as used in a narrow-band wave trap.



The r.f. section of the author's 250-watt transmitter was described in RADIO & TELEVISION NEWS for June, 1952. The modulator occupies the center section of the rack. The speech amplifier is below.

125-WATT AUDIO SYSTEM WITH CLIPPING

By ROBERT F. LEWIS, W8MQU

More effective use of the phone transmitter, with higher average modulation percentage is had in this audio unit for the author's 250-watt transmitter, described earlier. Multi-impedance output permits use with any transmitter.

SHORT paragraph at the end of the article entitled "A 250-Watt TVI-Proof Transmitter" which ap-eared in the June, 1952, issue of ADIO & TELEVISION NEWS, made men-on of the speech amplifier and modu-tor which are being used with the g. Since that time a number of eaders have sought additional in-ormation on the audio system; there-re it was decided to publish a com-lete description.

The feature which seemed to com-and the greatest interest was the peech amplifier, incorporating a low-vel clipper-filter system. In view of is fact, it would not be amiss to ve brief consideration to the theory nd reasons for the use of a clipper.

For years amateurs have tried vari-us methods to increase the effective-ess of their phone transmitters. They ave experimented with many sys-ems, such as supermodulation, vol-me compression, extended positive eak modulation, clipping, and others. asically the aim of each system is to et as much audio power as possible to the carrier and yet remain with- the limits of 100 per-cent modula-on.

Probably one of the simplest and ost economical methods of increas-g average audio power is low-level ipping. The very nature of the com-licated speech waveform makes the se of clipping practical. Unlike a ne wave, which is of uniform am-litude, the speech wave consists of erhaps 75 per-cent low-amplitude nergy with occasional peaks to sev-ral times the average value. Obser-ation of speech on an oscilloscope will quickly bear out this fact. It is unlawful to exceed 100 per-cent amplitude modulation of a transmitter carrier; therefore it is obvious that if all peaks are kept within those limits the average audio level will be low.

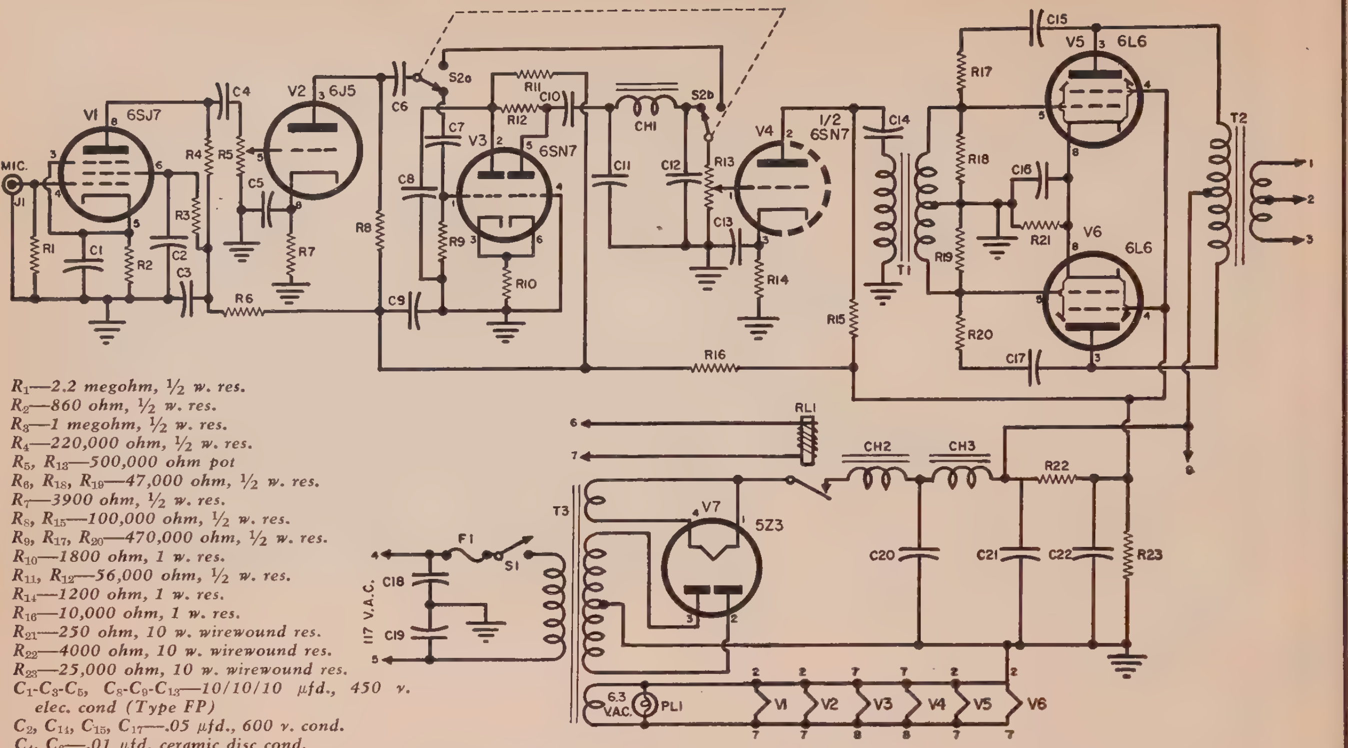
The main objection to overmodulation, especially in the negative direction, is that audio harmonic generation becomes excessive, resulting in adjacent-channel interference, commonly known as "splatter." Clipping is actually taking place when overmodulation occurs, but it is impossible to remove the high harmonic content at this stage of the game. However, if clipping is moved back into the audio system, then it becomes a simple matter to filter out the objectionable audio harmonics. This is done by passing the clipped signal through a low-pass filter having a cut-off frequency of around 3500 cycles.

Clipping and filtering can be accomplished in the output of the modulator itself. However, large amounts of reserve power are required to do the job at this point. It is much more economical to insert clipping in the speech amplifier, where only additional voltage amplification is required. As much as 20 db of clipping can be used, but the character of one's voice is lost at such drastic levels. A figure of 10 db or less, however, does not noticeably impair the quality, but it does give added punch to the signal.

There are several considerations to be observed in the design of a clipper amplifier. Inasmuch as the clipper-filter system tends to make the signal "bassy," it is necessary to compensate for this by reducing the low-frequency response in that portion of the amplifier preceding the clipper. In order to keep the phase distortion from nullifying the gain obtained by clipping, all stages following the clipper-filter should have very good bass response. Additional amplification is also required to compensate for the loss in signal level which results from clipping. It then follows that the plate supply should be well filtered to prevent hum due to the high gain of the amplifier.

Going from the theoretical to the practical design of a transmitter audio system, we first inspect the circuit of the speech amplifier to be described (see Fig. 1). The tube line-up consists of 6SJ7 and 6J5 voltage amplifiers, 6SN7 clipper stage, half of a 6SN7 functioning as a voltage amplifier, and a pair of 6L6's as power amplifiers. In the original design, both sections of the 6SN7 voltage amplifier were utilized. This system provided too much gain, however, and one section of the tube was eliminated from the circuit. A single 6J5 in this position would serve equally well.

The input to the clipper is controlled by a potentiometer, R_5, while the output level may be fixed by R_{13}. By adjusting R_5, the degree of clipping may be set. Transmitter modulation percentage is determined by the setting of R_{13}. If the operator desires to eliminate the clipper from the circuit he can do so by throwing S_2 so as to bypass the 6SN7 clipper and its associated filter system, the latter consisting of CH_1, C_{11}, and C_{12} in a low-pass circuit having a cut-off frequency of about 3500 cycles.



R_1—2.2 megohm, ½ w. res.
R_2—860 ohm, ½ w. res.
R_3—1 megohm, ½ w. res.
R_4—220,000 ohm, ½ w. res.
R_5, R_{13}—500,000 ohm pot
R_6, R_{18}, R_{19}—47,000 ohm, ½ w. res.
R_7—3900 ohm, ½ w. res.
R_8, R_{15}—100,000 ohm, ½ w. res.
R_9, R_{17}, R_{20}—470,000 ohm, ½ w. res.
R_{10}—1800 ohm, 1 w. res.
R_{11}, R_{12}—56,000 ohm, ½ w. res.
R_{14}—1200 ohm, 1 w. res.
R_{16}—10,000 ohm, 1 w. res.
R_{21}—250 ohm, 10 w. wirewound res.
R_{22}—4000 ohm, 10 w. wirewound res.
R_{23}—25,000 ohm, 10 w. wirewound res.
C_1-C_3-C_5, C_8-C_9-C_{13}—10/10/10 μfd., 450 v. elec. cond (Type FP)
C_2, C_{14}, C_{15}, C_{17}—.05 μfd., 600 v. cond.
C_4, C_6—.01 μfd. ceramic disc cond.
C_7—470 μμfd. ceramic cond.
C_{10}—.002 μfd. ceramic cond.
C_{11}, C_{12}—250 μμfd. ceramic cond.
C_{16}—100 μfd., 50 v. elec. cond.
C_{18}, C_{19}—Dual .005 μfd. ceramic cond.
C_{20}, C_{21}, C_{22}—4 μfd., 600 v. oil-filled cond.
T_1—Interstage trans. (Thordarson T20A25 or equiv.)
T_2—Driver trans., 6L6 class AB_1 plates to class B mod. grids (UTC S9 or equiv.)

T_3—Power trans. 360 v. d.c. rating (choke input) @ 200 ma.; 5 v. @ 3 amps.; 6.3 v. @ 4 amps.
CH_1—25 hy. filter choke (no d.c. in winding) (Merit C-2985 or equiv.—part of low-pass filter)
CH_2, CH_3—10 hy. @ 200 ma. filter choke
RL_1—S.p.s.t., 117 v. a.c. coil relay
PL_1—6.3 v. pilot light
F_1—3 amp. fuse (AGC-3)

S_1—S.p.s.t. toggle switch
S_2—D.p.d.t. rotary switch (Mallory No. 3222J —clipper "on-off")
J_1—Mike jack
V_1—6SJ7 tube
V_2—6J5 tube
V_3—6SN7 tube
V_4—½ 6SN7 tube
V_5, V_6—6L6 tube
V_7—5Z3 tube

Fig. 1. Schematic of the speech clipper-amplifier which drives the 811 modulator section (Fig. 2). Switch S_2 disconnects the clipper-filter section for "straight" operation. A 6J5 may be used for V_4. Terminal numbers refer to barrier strip screws.

It will be noted that inverse feedback is utilized in the 6L6 stage. This is a "must" when using the 6L6, or any other tube having high plate resistance, as a driver for class B modulators. By using inverse feedback, the performance of the 6L6 can equal that of a triode, such as the 2A3.

As was mentioned earlier, the low-frequency response of stages preceding the clipper should be poor, to compensate for loss of highs in the clipper-filter system. This is accomplished by the use of a small coupling condenser, 470 μμfd., at C_7. Following the clipper, however, the bass response is aided by the use of a large coupling condenser, .05 μfd., at C_{14}, and a large 6L6 cathode bypass condenser, plus inverse feedback.

For circuit details of the modulator which is used with the 250-watt transmitter, refer to Fig. 2. A pair of 811's is used as a class B amplifier, operating at a plate voltage of about 900 and with zero bias voltage on the grids. The 900-volt plate supply is an integral part of the modulator system and supplies only the 811's. Rectifying is done by a pair of *Taylor* 866 Jr's, while the filter consists of a single choke and two 2-μfd. oil-filled condensers. This seemingly small amount of filtering is adequate for a push-pull class B modulator stage, as the static current drawn by the 811's is low, and any small amount of ripple in the plate current is phased out in the modulation transformer primary winding.

Audio power from the speech amplifier output transformer is applied to terminals 7 and 9 of the modulator, while terminal No. 8 serves as a grid return and is connected to the tap of the driver transformer secondary. Terminals 3 and 4 supply the modulator power supply with 117 v., 60-cycle current. Operation of S_1 applies voltage to the 811 and rectifier filaments. Plate voltage is not available until S_2 and RL_1 are both closed, RL_1 being actuated by a remotely operated send-receive switch.

A special feature of the modulator stage is the use of a relay, RL_2, to short out the modulation transformer secondary when keying the r.f. section of the transmitter. If this precaution were not taken, it is conceivable that surges of final amplifier plate current could develop voltages in the modulation transformer which could break down its insulation. The relay used for this purpose is a *Guardian* Model R-100-B, having normally-closed contacts, a 117-volt a.c. coil, and high-voltage insulation. The coil is connected across the primary winding of the high-voltage transformer, T_4. When the modulator is in operation, RL_2 is actuated, opening the contacts and placing the secondary of the modulation transformer in the circuit. If the operator desires to go to c.w. it is only necessary to throw S_2 to the "off" position, simultaneously removing modulator plate voltage and shorting the modulation transformer secondary. All filaments are thus left on for instant return to phone operation.

The modulation transformer in this case is capable of handling 125 watts of audio power and will match any r.f. load to any class B modulator plates. Terminations are made in the writer's rig to match a load of 5000 ohms (813 final) to an 811 plate-to-plate load of 6000 ohms. The r.f. load is calculated by dividing the final plate voltage (1250) by the total 813 plate and screen current (about 250 ma.).

For mechanical details of the audio system refer to the top view of the speech amplifier. The tube line-up, starting at the top center of the photograph, is as follows: 6SJ7, 6J5 voltage amplifiers, 6SN7 clipper, 6SN7 voltage amplifier (in back of clipper tube), and 6L6 driver tubes. Directly behind the 6SJ7 stage is a type *FP* can containing C_1, C_3, and C_5, while the can behind the 6J5 stage houses C_8, C_9, d C_{13}. Between the 6SN7 and 6L6 bes is the interstage transformer, . The driver transformer is shown xt to the 6L6 stage.

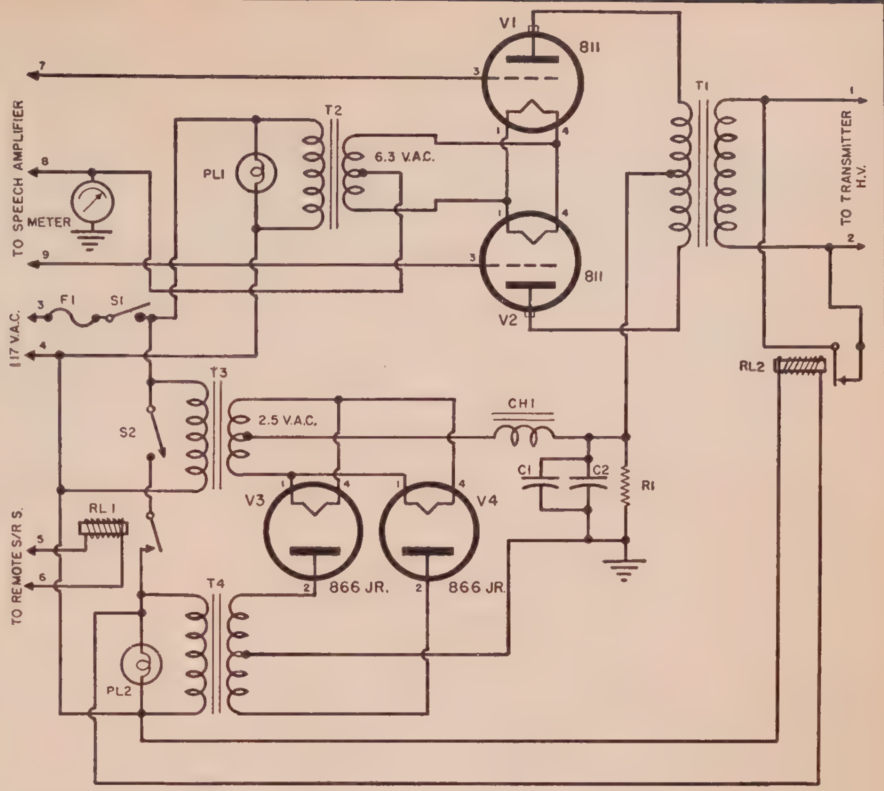
Power supply components are lined across the rear of the chassis, with e power transformer at the lower nter of the photograph, followed by e 5Z3 rectifier and two filter chokes. irectly in front of the filter chokes e the three filter condensers, C_{20}, $_{21}$, and C_{22}, which are all 4 μfd., 600 oil-filled units. Located on the ar of the chassis are terminals for dio output and supply voltage, plus fuse holder. Audio output is taken om terminals 1, 2, and 3, while a.c. imary connections are made to rminals 4 and 5. In the writer's odel, a remote-control relay is used, d 117 volts a.c. is supplied to the lay coil through terminals Nos. and 7. Terminal 8 provides a source approximately 360 volts which is ed to power a 6L6 amplifier in the dio-frequency section of the rig.

The under-chassis view shows the cation of small components and the uting of the wiring harness. The dio choke, CH_1 (Fig. 2), which rms a part of the low-pass filter, can seen near the center of the chassis.

Before inspecting the front panel ew, let us observe the location of rts on the modulator chassis. ocated at the approximate center are e 811 modulator tubes, while direct- to the left of the tubes is the modu- tion transformer. At the rear of e chassis, from the right hand side the photograph, are the high-volt- ge transformer, T_4, rectifier tubes, ter choke, CH_1, and the two filter ndenser, C_1 and C_2.

At the rear of the modulator chassis e terminals for output power and pply voltages. High-voltage feedrough insulators are used for the audio output terminals, No's. 1 and 2. A *Jones* barrier strip provides all additional terminations. Primary supply

(*Continued on page* 128)



R_1—50,000 ohm, 50 w. wirewound res.
C_1, C_2—2 μfd., 1000 v. oil-filled cond.
T_1—Mod. trans. (Any class B plates to any class C r.f. load, 125-watt audio rating unit may be used)
T_2—Mod. fil. trans., 6.3 v. @ 8 amps.
T_3—Rect. fil. trans., 2.5 v. @ 5 amps., 5000 v. insulation
CH_1—12 hy. 250 ma. filter choke
F_1—3 amp. fuse (AGC-3)
S_1, S_2—S.p.s.t. heavy-duty toggle sw.
RL_1—S.p.s.t. remote control relay, 117 v. a.c. coil
RL_2—S.p.s.t. relay, 117 v. a.c. coil (see text)
PL_1—Fil. pilot light
PL_2—Plate pilot light
Meter—0-300 ma. meter (Mod. plate current)
V_1, V_2—811 tube
V_3, V_4—866 Jr. tube (Taylor)

Fig. 2. Schematic of the modulator used in the author's 250-watt transmitter. Any modulator with similar drive requirements could be used instead. This one has some added operating conveniences and safety provisions, as discussed in the text. As it has a multi-impedance output transformer it may be used with other transmitters.

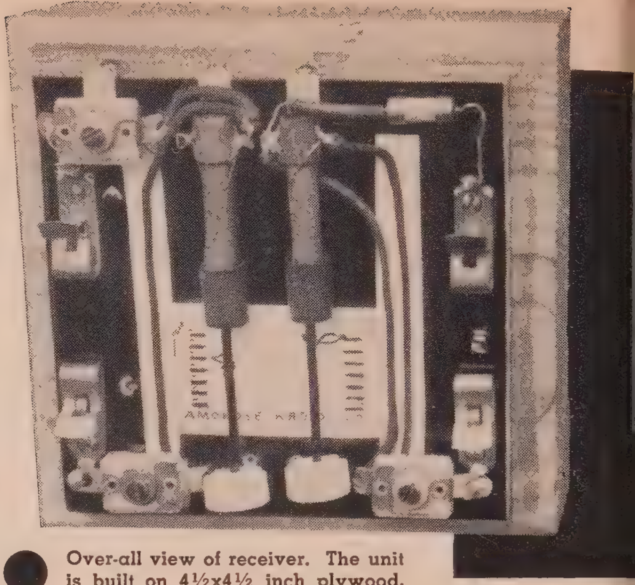
A top-rear view of the modulator. Filament transformers are under the chassis as are the relays and R_1. The 811 sockets are mounted below chassis on spacers to allow top clearance. Ceramic feedthroughs at left are for audio output (see text).

Top view of the speech amplifier-clipper. Placement of parts is straightforward, the layout almost following the circuit diagram. The clipper-circuit tube is small glass tube near the front panel, in center. The chassis is heavy aluminum.

FERRI-LOOPSTICK CRYSTAL RECEIVER

By **JOSEPH D. AMOROSE**

Details on a selective, high-sensitivity crystal receiver employing the recently developed ferro-magnetic coil units.



Over-all view of receiver. The unit is built on 4½x4½ inch plywood.

"BELIEVE it or not—over two million crystal radios are still in use," runs a recently published report of a radio owners' survey.

Revealed, too, were numerous good reasons for owning such a receiver. Many kept one as an "emergency" receiver to maintain constant contact with the radio station's vital source of information during power failures, storms, disasters, etc. Others had them for the children to listen to—"it keeps them quiet after they go to bed." Still others like crystal radios because they could listen without disturbing others in the room. A considerable number revealed they made a hobby of radio; they enjoyed trying out new arrangements and hookups. That there are many good reasons for owning such a receiver should be established beyond question.

Interest in crystal radio rose sharply when the war-developed germanium 1N34 diode became available to the public. This fixed-type crystal proved a real boon to the weary members of the "whisker-wiggling" fraternity. No longer was it necessary to search for "loud" spots—the 1N34 stayed "hot." It was stable, needed no re-adjusting, and it lasted for long periods. Best of all, it was relatively inexpensive. This put it within reach of many.

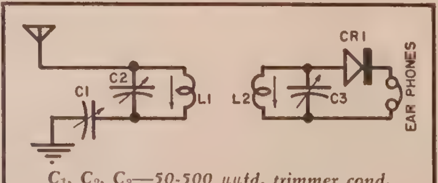
Yet, crystal receivers always had one serious drawback: selectivity was poor. Unless complicated circuits were used, tuning was "broad as a barn." When good selectivity was achieved, it invariably came at the expense of volume. This reduced much of the pleasure of listening.

Now, happily, a recent radio advance has come to the aid of the serious crystal set enthusiast, who all these years has been looking for real improvement. Referred to is the new Hi-*"Q"*, *Ferri-Loopstick* coil. Although intended primarily as an efficient replacement for the old form of loop antenna, these inductances are a "natural" for use in crystal receivers. They can be used in any part of a crystal circuit where the conventional type coils were formerly employed. Their high *"Q"* feature permits a degree of selectivity that was hitherto undreamed of. Tuning is sharper, sensitivity is higher. Employed in a standard crystal circuit, these coils, plus a few inexpensive components, can produce a degree of volume and sharpness of tuning that is beautiful to behold. Stations tune in with a sweet, selective "swish." No hash, no jumble of sounds, no annoying crosstalk is experienced. The tone is crisp, sharp, and clear. It leaves nothing to be desired.

For the hobbyist and constructor interested in trying out this new development, he will find the receiver described well worth his time. Parts required are few and inexpensive. A boy can put them together in 40 minutes. Essential components consist of three trimmers, two *Ferri-Loopsticks*, 1N34 diode, and four *Fahnestock* clips, all to be mounted on a 4½ inch square piece of ⅜ inch thick plywood.

A glance at the circuit will show it is a straightforward, two circuit hookup, familiar to most old-timers. The coils should be mounted first. Best coupling is secured by spacing the coil brackets exactly ½ inch apart. (Closer coupling will give higher volume at the expense of selectivity, however). The enameled wire that comes attached to the coil can be used as one lead; another lead is soldered to the other side of the coil. A match stem should be cemented to each coil's core to facilitate sliding of the core. Two toothpaste tube caps can be attached to the match stems to permit easier tuning. These two cores do all of the tuning. Leads should be kept as short as possible. Solder all connections carefully. A 100 ft. antenna, erected as high as possible, should be hooked to "antenna," and a short ground to the nearest cold-water pipe should be attached to "ground."

Circuit diagram of crystal receiver. Only six components are required in construction.



C₁, C₂, C₃—50-500 μμfd. trimmer cond.
L₁, L₂—"Ferri-Loopstick" (Grayburne)
CR₁—1N34 germanium diode

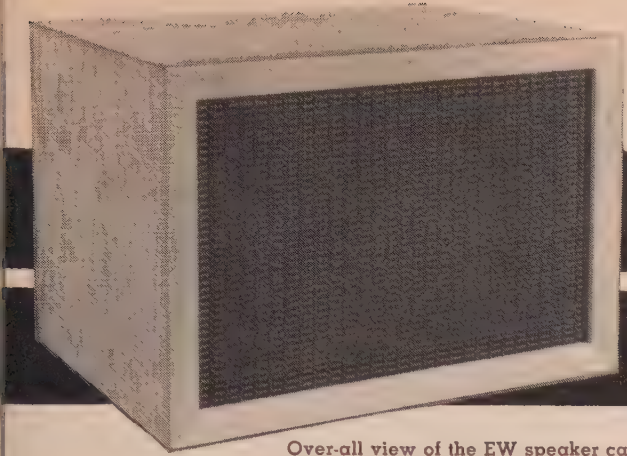
After the set is completed, pull out both coil cores so that they are nearly all the way out—this position corresponds to the high-frequency end of the radio dial. Select a station transmitting on about 1500 kc. and adjust all three trimmers for maximum volume, moving the cores in and out slightly, until an optimum setting is achieved. This is the only adjustment required. Thereafter, all remaining stations up to 550 kc. are tuned in by sliding both cores inward, at the same time. If the trimmer adjustments have been correctly made, both circuits will track properly, and the cores will be equidistant in the coils on each station's setting.

A chart should be placed under the match stems for easy logging. For a pointer, wind a piece of black enameled wire around a matchstick, for example. With a log, stations can be tuned in very quickly; settings won't vary.

NOTE: Tuning of the cores is very sharp and must be done very slowly otherwise the station will be passed by unheard. Most of the stations in the BC band can be tuned in with the cores traveling less than one inch. From this, the very high degree of selectivity becomes evident. Mounting the set on a 5-inch square wooden block will add weight to the set and permit much easier and more accurate tuning.

In Richmond, Va., this set receives

(*Continued on page* 88)



Over-all view of the EW speaker cabinet.

EW SPEAKER ENCLOSURE

By

JAC HOLZMAN

G & H Wood Products Co. (Cabinart)

THE author's need for a "portable" speaker enclosure for "on location" recording work dictated the design of this *EW* speaker enclosure to be described herein. It is now being manufactured commercially by *G & H Wood Products Co.* (*Cabinart*), of 75 N. 11th St., Brooklyn 11, N. Y.

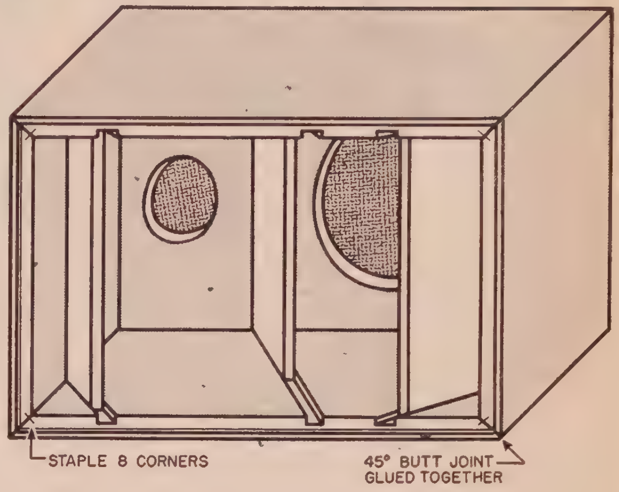
Three criteria were set up covering the design of this enclosure: 1. small size, 2. smooth response, and 3. high efficiency. In order to increase the length of the air column in a bass-reflex type cabinet, it was decided to insert a length of board (A) at an angle of 20 degrees to normal. This increased the air column by a half without increasing the over-all dimensions of the enclosure.

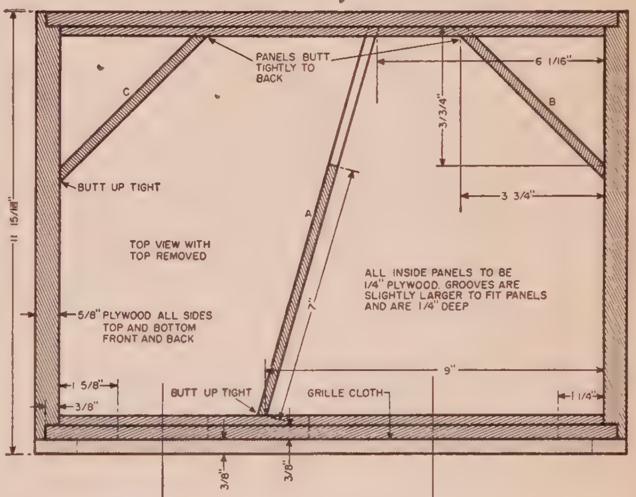
This idea is not new but the length of (A) creates two matched chambers within the enclosure and aids in boosting the low-end response of bass-shy 8-inch speakers.

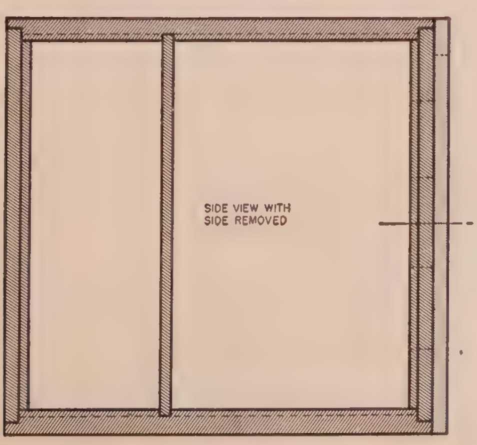
Sound reflects from hard surfaces at an angle of 90 degrees. Most standard reflex enclosures are lined with cotton or *Celotex* to absorb high-frequency radiation that ordinarily reflects uncontrolled inside the speaker cabinet. Fins (B) and (C) block the right angles at the corners, thereby eliminating the need for sound damping substances. In this way the sound efficiency is increased as the entire back wave can be used.

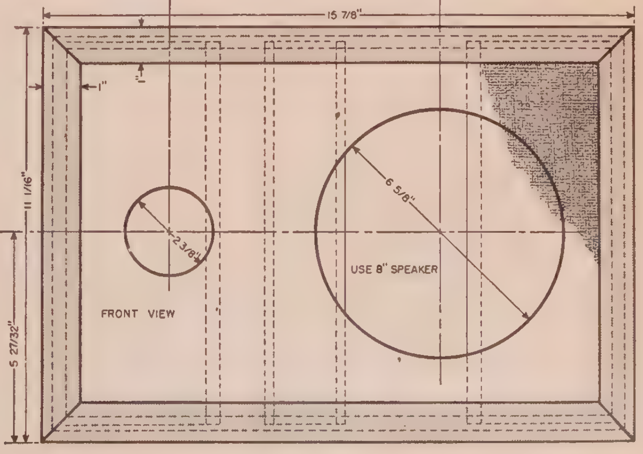
Tuning the port was the next consideration. The standard formula for determining port size proved useless since lengthening the air column had, in effect, created a "volume" that could not be conveniently measured with a ruler once this baffle had been constructed. An evening spent with an a.f. generator and the v.t.v.m. solved this problem.

(*Continued on page* 86)




PANELS BUTT TIGHTLY TO BACK
C
B
A
6 1/16"
3/3/4"
3 3/4"
BUTT UP TIGHT
11 15/16"
TOP VIEW WITH TOP REMOVED
ALL INSIDE PANELS TO BE 1/4" PLYWOOD. GROOVES ARE SLIGHTLY LARGER TO FIT PANELS AND ARE 1/4" DEEP
7"
5/8" PLYWOOD ALL SIDES TOP AND BOTTOM FRONT AND BACK
9"
1 5/8"
3/8"
BUTT UP TIGHT
GRILLE CLOTH
1 1/4"
3/8"
3/8"





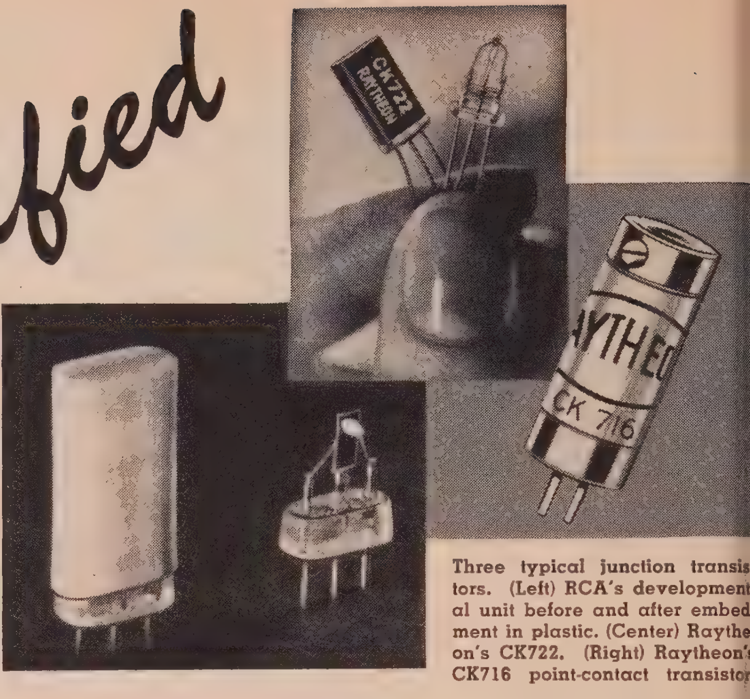
TRANSISTOR PHYSICS *Simplified*

By

S. P. GENTILE & **P. J. BAROTTA**

Sig. Corps Pub. Agency
Fort Monmouth, N. J.

Dir., Hudson Tech. Inst.
Union City, N. J.



Three typical junction transistors. (Left) RCA's developmental unit before and after embedment in plastic. (Center) Raytheon's CK722. (Right) Raytheon' CK716 point-contact transisto

Part 1. An easy-to-understand explanation of how and why transistors operate, their characteristics, and limitations.

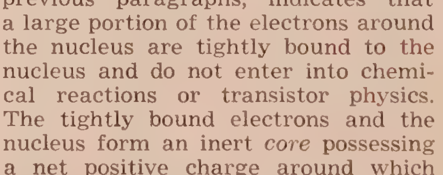
THE transistor is at present emerging from the laboratory and being applied as a practical engineering device for amplification and generation of electric signals, and for a multitude of other applications in which the vacuum tube normally was used. It is to be expected at this stage of development of the transistor, that very little material which is understood easily by the average engineer and technician is available on its theory of operation. A great deal of material is available to the physicist and the advanced engineer (see bibliography), which does not serve the need of the average technician and engineer. The writers have sensed this need, and have prepared these articles specifically for those who wish a non-mathematical presentation of the transistor.

The following paragraphs discuss first the theory of operation of the junction transistors and then the theory of operation of point-contact transistors. This is done deliberately, because the theory of the junction transistor is more easily understood, and an understanding of its operation facilitates the presentation by the writers, and comprehension by the reader, of the theory of the point-contact transistor.

Atomic Structures

The basic building blocks of matter are *electrons, protons,* and *neutrons.* Electrons possess a negative charge. Protons possess an equivalent positive charge and are 1835 times heavier than the electron. The neutron possesses no charge and has the same mass as the proton. A specific configuration of electrons, protons, and neutrons produce the next largest building block which is the *atom.* The atom consists of a nucleus of protons and neutrons around which the lighter electrons rotate. Since there are as many electrons (negative charge) outside the nucleus as there are protons (positive charge) inside the nucleus, the atom is electrically neutral. The atom of one chemical element differs from the atom of another chemical element only in the number of electrons, neutrons, and protons that they possess. For transistor physics the atoms of only a few elements of the more than ninety known elements are of interest. These are germanium, silicon, antimony, arsenic, aluminum, and gallium. A more detailed study of atoms than that presented in the previous paragraphs, indicates that a large portion of the electrons around the nucleus are tightly bound to the nucleus and do not enter into chemical reactions or transistor physics. The tightly bound electrons and the nucleus form an inert *core* possessing a net positive charge around which the remainder of the electrons rotate. Transistor physics is concerned with the net charge on the core and the electrons surrounding the nucleus. For that reason the germanium atom, which has 32 protons in its nucleus and 28 tightly bound electrons around it, is represented by a circle containing a net charge of +4 (the core) and four electrons (the dashes) as indicated in Fig. 1A. The net charge on the core of the silicon atom is also four, and is therefore represented in the same manner as germanium. Silicon is mentioned here only to indicate that transistors can be made of silicon as well as germanium. However, the great bulk of experimental investigation has centered on the latter, and this discussion is concerned chiefly with germanium crystals. Pure germanium is of no use for producing transistors. The phenomena of rectification and amplification of current by germanium is made possible because of the presence of impurities in the crystals.

Fig. 1. Atomic structures. (A) germanium or silicon, (B) antimony or arsenic (donors), and (C) aluminum or gallium (acceptors).



One type of impurity of importance in the germanium crystals is known as a *donor.* The reason for the choice of this name will become apparent. Antimony or arsenic becomes a donor when it joins the crystal structure of germanium. The net charge on the core of the antimony or arsenic atom is +5 and five electrons surround the core. This is shown in Fig. 1B.

Another type of impurity of importance in the germanium atom is known as an *acceptor.* The reason for the choice of this name also will become apparent as we progress through this article. Aluminum or gallium becomes an acceptor when it joins the crystal structure of germanium. The net charge on the core of aluminum or gallium is +3 and three electrons surround the core. This is shown in Fig. 1C.

Crystal Structures

A schematic representation of a pure germanium crystal is shown in Fig. 2A. Note that each atom has four neighbors which are equidistant from each other. Between the cores of the atoms and each of their neighbors are o electrons (shaded area). These m *electron-pair bonds* which come o existence when two or more ms approach each other. Electrons in constant motion around the e, and electron-pair bonds are med when the movements of two ctrons, one from each atom, are ordinated. This co-ordination atcts the cores towards each other. wever, the positive charges on the es cause them to repel each other til a perfect balance of attraction d repulsion is obtained. The latter ndition is known as the condition equilibrium.

Pure germanium crystals, as deribed, have no application in the ld of transistors. In this form they e good insulators, having a high lectric constant of 16. The presce of a donor in a germanium crysl is of great importance in transistor ysics. When a donor atom (antiony or arsenic) joins the crystal ructure of germanium, it must lose e of its electrons which surround e core due to the fact that only four ctrons can form electron-pair bonds th the electrons of adjacent geranium atoms. The one electron which nnot form an electron-pair bond bemes an *excess electron* which is free move through the wide spaces beeen the cores, as shown in Fig. 2B. a matter of fact, the excess elecon can move through the crystal as ough it were in a vacuum.

If a battery were placed across the ystal, the electron would accelerate wards the positive terminal of the ttery and enter the positive terinal.

Simultaneously an electron would erge from the negative terminal to ter the crystal. Thus a continuous nduction of electrons would be mainined through the crystal. The cores the donor and the germanium reain stationary at all times.

Germanium crystals which contain nor impurities are known as *n*-type rmanium. It is obvious that the *n* ems from the fact that conduction rough the crystal is mainly a conction of *negative* charges, namely cess electrons from the donor atoms. this point in the discussion, it is felt that a definition of the term *donor* can be fully appreciated: a donor is an element, which, when it joins the crystal structure of germanium, gives off an excess electron.

The presence of an acceptor in germanium crystals is also of great importance in transistor physics. When an acceptor atom (aluminum or gallium) joins the crystal structure of germanium, it must do so by accepting an electron from one of its neighbors in order to complete four electron-pair bonds with its neighbors. In accepting an electron from one of its neighbors, it leaves a *hole* in another electron-pair bond, as shown in Fig. 2C. Obviously the hole will have the equivalent charge of an electron, but it will be positive.

Experiment has shown that the hole is free to move throughout the structure. Conduction of current can take place through a germanium crystal containing an acceptor just as readily as it can through a germanium crystal containing a donor. However, the conduction mechanism is different. If a battery were placed across the crystal, a hole, as shown in Fig. 2C, would accelerate toward the negative terminal. An electron from this terminal would enter the crystal and fill the hole. Simultaneously, an electron from an electron-pair bond in the crystal and near the positive terminal of the battery would leave the crystal and enter the battery. In so doing, a hole is created in the crystal, and the action is repeated. Continuous current flow through the crystal thus can be maintained.

Germanium crystals which contain acceptor impurities are known as *p*-type germanium. It is obvious that the *p* stems from the fact that conduction through the crystal is mainly a conduction of *positive* charges (holes). At this point, then, a definition of *holes* and *acceptors* is apropos. A *hole* is an incomplete group of electrons whose general properties approximate those of an electron, but differs from an electron in that it bears a positive charge. An *acceptor* is an element which, when it joins the crystal structure of germanium, produces a hole.

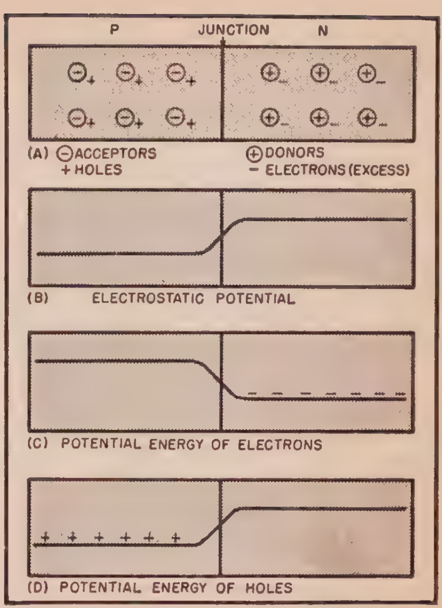

P
JUNCTION
N
(A) ⊖ACCEPTORS
+HOLES
⊕DONORS
− ELECTRONS (EXCESS)
(B) ELECTROSTATIC POTENTIAL
(C) POTENTIAL ENERGY OF ELECTRONS
(D) POTENTIAL ENERGY OF HOLES

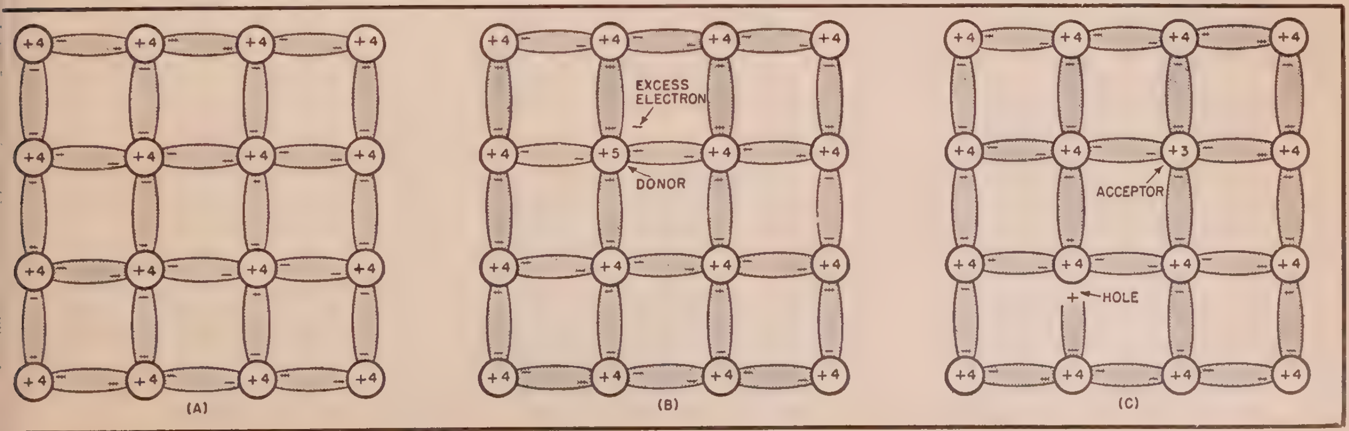
Fig. 3. The "p-n" junction under equilibrium conditions. See text for details.

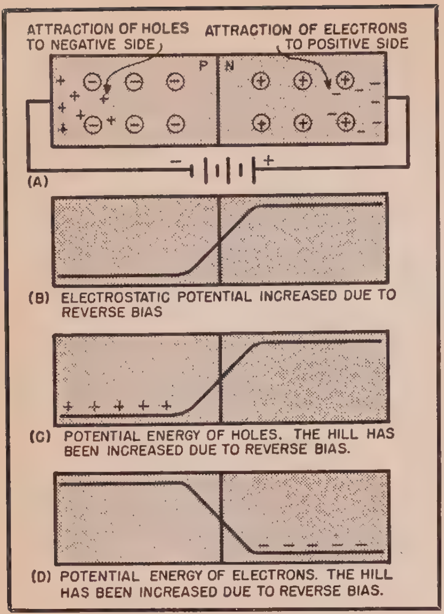
P-N Junctions

The radio-television technician and engineer have been aware of the fact that germanium diodes have been used for rectification for a very long time. No doubt, they have serviced or designed equipment using these diodes as second detectors and a.v.c. (automatic volume control) circuits; but they probably never knew exactly what conduction mechanism was involved to cause the rectification. In this section, the writers will attempt to explain how rectification takes place in a germanium diode, not because this article is interested in germanium diodes as such, but because the theory involved is essential to an understanding of current multiplication in transistors.

It has been pointed out that pure germanium crystals are good insulators. It has also been mentioned that *p*-type germanium or *n*-type germanium are relatively good conductors, and can conduct current equally well in either direction. Rectification with a germanium crystal (that is, high conductivity in one direction and high resistance in the other direction) oc-

Fig. 2. (A) Representation of electron-paired bonds in germanium. (B) Presence of a donor in a germanium crystal. (C) Presence of an acceptor in a germanium crystal. Refer to text for an explanation of these phenomena.




ATTRACTION OF HOLES TO NEGATIVE SIDE
ATTRACTION OF ELECTRONS TO POSITIVE SIDE
P
N
(A)
(B)
+ + + + +
(C)
(D)

(B) ELECTROSTATIC POTENTIAL INCREASED DUE TO REVERSE BIAS

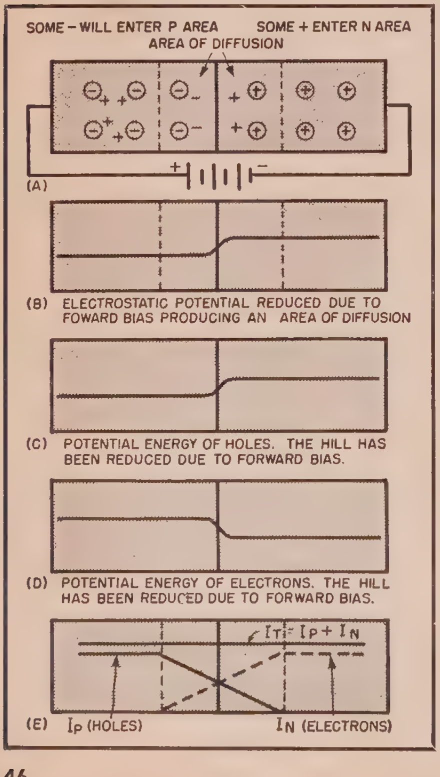
(C) POTENTIAL ENERGY OF HOLES. THE HILL HAS BEEN INCREASED DUE TO REVERSE BIAS.

(D) POTENTIAL ENERGY OF ELECTRONS. THE HILL HAS BEEN INCREASED DUE TO REVERSE BIAS.

Fig. 4. The "p-n" junction with reverse bias applied under various conditions.

curs when the *p*-type germanium and the *n*-type germanium are placed side by side. The plane at which the two types of germanium meet is called a *p-n* junction. The phenomenon which occurs at the junctions is of major importance. Fig. 3A illustrates a *p-n* type junction in a state of equilibrium. The holes concentrate to the left of the *p*-type germanium and the (excess) electrons concentrate to the right of the *n*-type germanium. This is caused by the electrostatic potential distribution produced by the acceptor and donor atoms as indicated in Fig. 3B. The electrons remain in the region of highest electrostatic potential, and the holes remain in the region of lowest electrostatic potential. When the electron is in the region of highest electrostatic potential, its potential energy is at a *minimum,* as shown in Fig. 3C. Since *potential energy* means the ability to do work, and since the electron cannot move to do work after it reaches the point of highest electrostatic potential, it is obvious that it is in a region of low potential energy. It is important to comprehend this statement because transistor physics is explained most readily in conjunction with potential energy diagrams. What has been said of the electron is also true of the hole. When the hole is in a region of lowest electrostatic potential (that is, when the hole is in a region of low negative potential), its potential energy is at a minimum (see Fig. 3D). Holes and electrons will flow into regions of low potential energy only. A low potential energy region for electrons is a high potential energy region for holes, and *vice versa.*

Fig. 5. The "p-n" junction with forward bias applied. See Fig. 4. shown above.



(B) ELECTROSTATIC POTENTIAL REDUCED DUE TO FOWARD BIAS PRODUCING AN AREA OF DIFFUSION

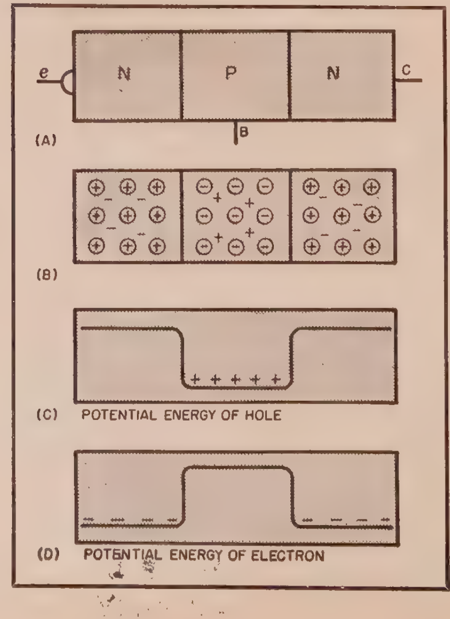
(C) POTENTIAL ENERGY OF HOLES. THE HILL HAS BEEN REDUCED DUE TO FORWARD BIAS.

(D) POTENTIAL ENERGY OF ELECTRONS. THE HILL HAS BEEN REDUCED DUE TO FORWARD BIAS.

(E) I_P (HOLES) I_N (ELECTRONS)

If a battery were connected across a *p-n* germanium crystal with the polarity indicated as in Fig. 4A, there would be no conduction of current through the crystal. This method of connection, with the positive terminal of the battery to the *n*-type germanium, and the negative terminal of the battery to the *p*-type germanium, is known as the *reverse bias* connection. It is obvious that the positive terminal of the battery will attract the electrons and cause them to concentrate still further to the right than under equilibrium conditions. The negative terminal of the battery will attract the holes and cause them to concentrate still further to the left than under equilibrium conditions. As a result, there will be no flow of electrons to the left and no flow of holes to the right. The difference in electrostatic potential between the two types of germanium has been increased as indicated in Fig. 4B. The potential energy hill for the holes has been i creased; they will not flow up th steep hill, as shown in Fig. 4C. Th same can be said for the potenti energy hill of electrons (see Fig. 4D

Fig. 6. An "n-p-n" type junction transistor under conditions of equilibrium.



(C) POTENTIAL ENERGY OF HOLE

(D) POTENTIAL ENERGY OF ELECTRON

If a battery were connected acro a *p-n* germanium crystal with th polarity indicated in Fig. 5A, a cu rent would flow, the magnitude which depends on the strength of th applied voltage. This method of co nection, with the positive terminal the battery connected to the *p*-ty germanium, and the negative termin of the battery connected to the *n*-ty germanium, is known as the *forwa bias* connection. The positive termin of the battery repels the holes a causes them to flow towards the type germanium. The negative te minal of the battery repels the ele trons and causes them to flow towar the *p*-type germanium. In a sma region on either side of the *p-n* jun tion, electrons and holes combine. F each hole that combines with an ele tron from the *n*-type germanium, electron from an electron-pair bo in the crystal and near the positi terminal of the battery, leaves th crystal and enters the positive te minal of the battery. Thus, a ne hole is created which flows towar the *n*-type germanium. For each ele tron that combines with a hole, electron enters the crystal from th negative terminal of the battery. Th current flow in the *p*-region is su stantially a flow of holes, and th current flow in the *n*-region is su stantially a flow of electrons. Fi 5E shows graphically the curren that flow throughout the crystal. Th total current I_t is constant, I_p (curre by holes) is a solid line, and I_n (cu rent by electrons) is a dashed line.

Fig. 5B shows that the electrostat potential between the *p*-type germ nium and the *n*-type germanium reduced greatly by the application a forward bias. Figs. 5C and 5D sho that the potential energy hills f holes and electrons are reduced su stantially, so that holes can climb th small hill to move into the *n*-type ge manium and electrons can move in the *p*-type germanium.

By applying the theory just pr sented, one can understand the ph nomenon of rectification in germaniu crystals. When the applied volta produces a forward bias, the cryst acts as a low resistance. When th applied voltage produces a rever bias, the crystal acts as a very hi resistance.

Junction Transistors

An *n-p-n* junction transistor formed by placing a narrow strip *p*-type germanium between two rel tively long strips of *n*-type germ nium, as shown in Fig. 6A, which not drawn to scale, to simplify repr sentation. Separate low-resistan contacts are made to each strip. T *n*-type germanium on the left is call

(*Continued on page* 100)

THE MONIMETER

By

LLOYD V. BRODERSON

W6CLV

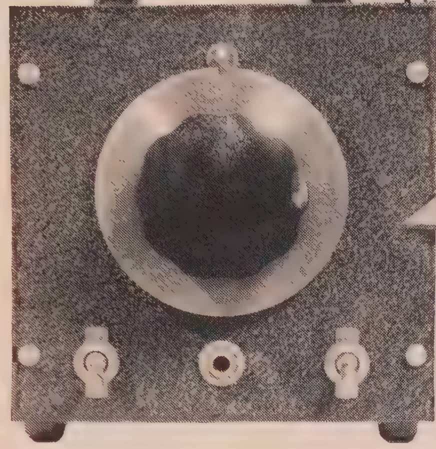
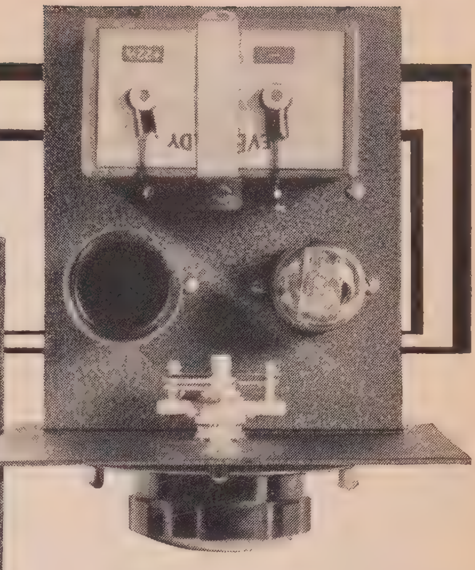



Fig. 1. The "Monimeter." Left, front-panel view, showing bandswitch, phone jack, and filament switch across bottom. Right, top-of-chassis view. The unit is completely self-contained in a 6"x6"x6" utility box.

The functions of a frequency meter and monitor can easily be combined in one unit. This one is extremely simple and yet highly effective. Construction is with simple tools.

WHILE monitors and frequency meters are customarily referred to as separate instruments, it is ossible to combine the two without acrificing the merits of either. Here-h is described such a unit—the "Mo-imeter."

Functioning as a heterodyne fre-uency meter, it is sufficiently ac-urate to insure "in-band" operation. 'undamental operation on 3.5 and 7.0 1c. is obtained with a tapped grid oil and a single plate winding. Grid 1ductance is reduced by the simple xpedient of shorting out turns. Un-ke harmonic operation, in which the ignal strength invariably decreases s the higher frequencies are ap-roached, the "Monimeter's" signal is f equal intensity on both channels.

As a monitor, operating on these wo popular bands, it will enable the ransmitting amateur to conform with CC regulations governing type A-1 ransmissions. A veritable "tattle-ale," it will quickly show up objec-ionable keying characteristics and ndesirable emissions.

Lightweight, compact, and relative-/ inexpensive, the unit occupies but ttle space. With normal usage its elf-contained dry batteries will be ound most economical.

Circuit

The circuit of Fig. 2 is standard 'ith the exception of the omission of ne usual grid condenser and resistor. 'hese components become unneces-ary when working in close proximity o a transmitter or receiver and have urposely been omitted.

The extremely low filament and late current rating of the type 1G4GT ube strongly recommends its use as regenerative detector. Satisfactory peration is obtained with midget-size A" and "B" batteries.

C_1 and C_2 are bandspread and band-et condensers respectively. Manipula-ion of these two capacitances allows ne to "spot" the band at any desired ial division. S_1, when closed, permits ındamental operation on 7.0 mc. /ith S_1 open the grid circuit is res-nant on 3.5 mc.

Inasmuch as most components are t ground potential, wiring is greatly mplified and capacity effects mini-iized.

Construction

A 6" x 6" x 6" steel utility cabinet ouses the entire unit. These cases are available in gray or black crackle finish, with attached chassis and front and rear panels removable. The original self-tapping screws were replaced with 8-32 machine screws to provide a more rigid assembly.

Centered on the front panel is the main tuning condenser dial and dial indicator. The lower left portion of the panel carries the band change switch while the lower right portion is occupied by the on-off "A" battery toggle switch. Between the two is positioned a closed-circuit jack.

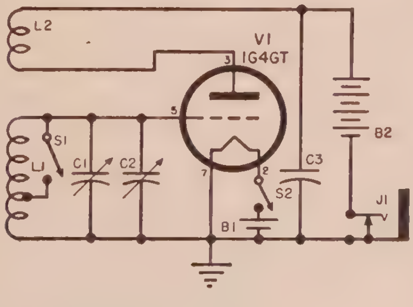
The photographs clearly depict constructional details. Much time and patience will be saved by closely following the circuit of Fig. 2. Inasmuch as no less than seven grounded leads are terminated at some point on the front panel or chassis, it will facilitate wiring if these grounded points are prepared in advance.

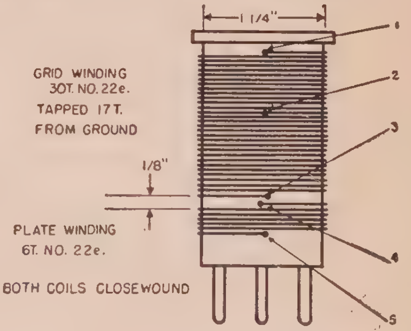
All wiring is of #18 solid pushback excepting those leads to the "A" battery plug which are flexible. Lock washers are used generously to insure mechanical stability.

The under chassis view shows the

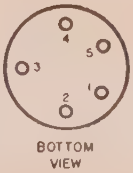
(*Continued on page* 115)

Fig. 2. Circuit diagram, parts list, and coil diagram for the "Monimeter." Only one coil form (standard 1¼") is needed for 80 and 40 meters. Note the absence of the usual grid condenser and resistor. No antenna is needed for this type of monitor.





C_1—15 μμfd. midget var. cond.
C_2—3-36 μμfd. trimmer cond.
C_3—200 μμfd. mica cond.
S_1, S_2—S.p.s.t. bat-handle toggle switch
B_1—1.5 v. "A" battery (RCA #VS070)
B_2—22½ v. "B" battery (Eveready #763)
J_1—Closed-circuit midget jack
L_1, L_2—See coil diagram at right
V_1—1G4GT tube (RCA)
Note: Dial and indicator are National Type O with HRK knob



PIN	CONNECTION
1	GRID
2	TAP
3	GROUND
4	B-PLUS
5	PLATE

U. OF L
LIBRARY

KNOW YOUR 1953 RCA TV RECEIVER*

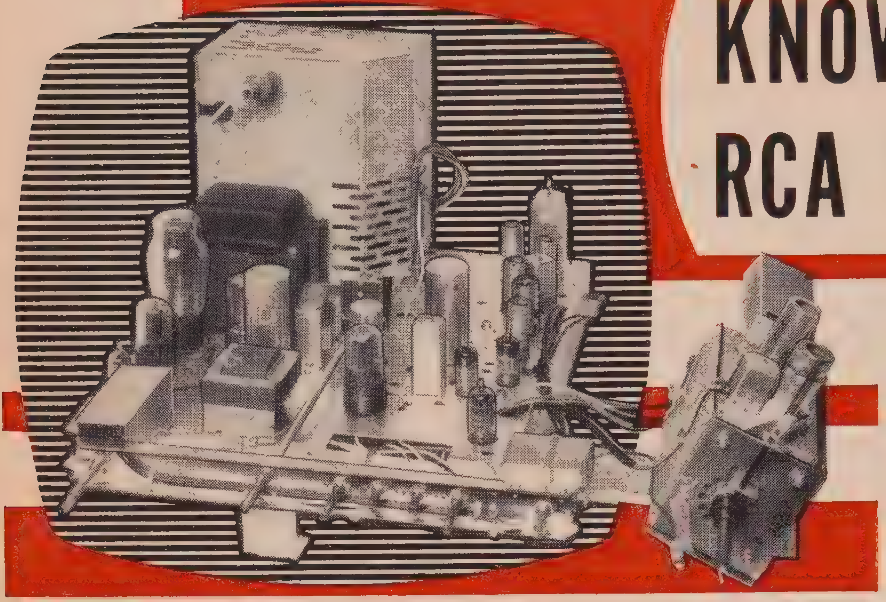


Fig. 1. The RCA Victor KCS-82 chassis shown with the KRK-11 v.h.f. tuner on the right. This chassis, with a KRK-12 tuner, receives both u.h.f. and v.h.f.

For better, faster servicing; the complete schematic diagram, circuit explanation, and RCA alignment data.

OF THE many design features of the new *RCA Victor* television chassis, the most significant are the relocation of front-panel controls and the addition of a u.h.f.-v.h.f. tuner in "U" model receivers. To illustrate the new locations of the controls, the KCS-82 chassis with a KRK-11 tuner is shown in Fig. 1. This chassis, as with other current *RCA Victor* chassis, will be used with either a v.h.f. tuner (KRK-22) or a combination u.h.f.-v.h.f. tuner (KRK-12). The receiver models which use KRK-12 have a "U" suffix added to the model number. Thus, Model 21T303 is a 21-inch receiver which includes the KCS-82 chassis with the KRK-22 (v.h.f.) tuner. Model 21T303U is a 21-inch receiver which includes the same chassis but with the KRK-12 (u.h.f.-v.h.f.) tuner. In early production models, the KRK-11, an r.f. tuner similar to the KRK-22, is used with the KCS-82 chassis.

The location of controls at the chassis front places the Fine Tuning and Channel Selector at their familiar positions on the right-hand side of the chassis. The "On-Off"/Volume and Brightness controls are relocated at the left-hand side. These four controls are the main tuning controls that are visible to the television operator.

Midway between the main controls, a group of auxiliary tuning controls and service adjustments are mounted behind a hinged cover on the receiver cabinet. When the cover is flipped downward, the concealed controls become accessible for adjustment.

The auxiliary tuning controls consist of the Picture Control, TV-Tone-Phono switch, Horizontal Hold, and Vertical Hold. The position of these controls is shown in Fig. 4. The first two are equipped with knobs for ease of turning. The two hold controls are provided with knurled-end shafts.

Two service adjustments, Height and Vertical Linearity, are also included with the concealed front-panel controls to permit the service technician to make these adjustments conveniently. To discourage unnecessary adjustments, each control has a short shaft with a slotted-end. Other service adjustments are located on the chassis rear apron (See Fig. 3). These include the a.g.c., width, as well as the horizontal linearity, drive, locking range, and frequency adjustments.

KRK-12 U.H.F.-V.H.F. Tuner

To fulfill its function of sixteen-channel u.h.f. and v.h.f. coverage, the KRK-12 tuner uses a rotary drum into which tuned u.h.f. and v.h.f. inserts are placed. As it leaves the factory, the KRK-12 is equipped with twelve v.h.f. inserts and four blank inserts. The twelve v.h.f. inserts cover Channels 2 through 13. The four blank inserts can be exchanged (at *RCA Victor* distributors) for four inserts in the u.h.f. band which provide u.h.f. coverage in a particular area. If desired, any combination of sixteen u.h.f. and/or v.h.f. inserts may be used in the KRK-12.

On each insert are mounted tuned circuits which are connected into the r.f., mixer, and oscillator stages of the KRK-12 so as to function on a selected u.h.f. or v.h.f. channel. In the r.f. circuit, the antenna coil has a 300-ohm input for either u.h.f. or v.h.f. operation. An additional 72-ohm antenna input is provided for u.h.f. operation. When the 72-ohm input is used, the 300-ohm link coupling coil (L_{10} and L_{13} in Fig. 6) has to be removed from the u.h.f. inserts that are used. This prevents antenna coupling from two sources into the u.h.f. circuits.

Two 43.5 mc. i.f. traps are located in the antenna circuit common to both u.h.f. and v.h.f. These are identified as L_1-C_1 and L_2-C_2 on the KRK-12 tuner diagram, Fig. 6. A tunable FM trap (not shown on the diagram) is mounted along the 300-ohm antenna input lead. The trap consists of a 4⅜ inch length of 300-ohm line with one end shorted and the other end terminated with a 5-70 μμfd. trimmer condenser.

From the antenna coil the signal is coupled, for u.h.f. operation, through a triple-tuned circuit (which includes the antenna coil) to the mixer stage. For v.h.f. operation, the signal is fed through the r.f. amplifier stage V_1 and then to the mixer stage. V_1 uses a type 6BQ7A tube connected in a driven grounded-grid amplifier circuit. An additional 43.5 mc. i.f. trap (L_7-C_{16}) is located in this stage.

The mixer stage is used alternately for u.h.f. or v.h.f. operation. A silicon crystal diode performs the mixing action of the r.f. and oscillator signals. The mixer tank circuit for u.h.f. operation is the output coil and condenser of the triple-tuned circuit (L_5-C_8, for example, in Fig. 6); for v.h.f. operation it is the secondary coil and condenser of the r.f. amplifier plate transformer (L_{21}-C_{34}, for example). (Symbol numbers used here are for illustration only because of the variation of numbers with the different inserts). Oscillator voltage is not injected directly into the mixer tank circuit for u.h.f. operation but is coupled into the mixer stage through an inductance placed close to the os-lator tank circuit. The inductance connected between the ground end the mixer tank and the chassis ound of the tuner. The amount of ductance is made variable so that e u.h.f. oscillator injection voltage n be adjusted to its correct level. his adjustment is accessible on top the chassis (See Fig. 4) between e oscillator tube and the crystal ixer. For correct u.h.f. mixer opera-on, the crystal mixer current should between 0.3 and 3.0 ma. This can measured at the test point *TP_1* as voltage drop across *R_{10}*, a 100-ohm, ystal biasing resistor. *TP_1* is located ljacent to the u.h.f. oscillator injec-on adjustment on top of the chassis. ith a v.t.v.m. placed between *TP_1* d chassis ground, the injection ad-stment can be made to give a read-g of between 0.03 volt and 0.3 volt, hich can be read on a 1.5-volt scale.

---

*Prepared by the Commercial Service Section, RCA Service Company, Inc.

Going to v.h.f. mixer operation now, e oscillator injection voltage to the ixer is capacitively coupled on Chan-ls 2 through 6 and is inductively upled on Channels 7 through 13. he correct level of injection voltage nd consequently, crystal mixer cur-nt) can be measured at *TP_1* as is ne for u.h.f. operation. If a reading between 0.03 volt and 0.3 volt is t obtained, and it is known that the ned circuits are properly aligned, e crystal mixer and oscillator tube ould be first suspected to be at fault. not, then other circuit components ould be checked until normal cir-it operation is established and the rrect reading is obtained.

The oscillator stage uses a type F4 tube in a modified Colpitts cir-it. The oscillator output is taken the fundamental frequency for all annels, 2 through 83. Oscillator ltage is developed in the tank cir-it formed by *C_{12}*, *C_{13}*, the fine tuning ntrol and tuning components lo-ted on each insert. The values and lerances of these components should carefully noted when replacement required. Tube and wiring capaci-es also are significant in this circuit.

To maintain stable oscillation over is wide range of frequencies, the cillator plate voltage is held to the mits of 85 to 115 volts by a voltage ntrol tube, *V_4*. This tube is wired series with the oscillator plate sup-y and acts as a variable resistance hich changes value in proportion to e current flow. The conduction rough *V_4* and, consequently, the os-lator plate voltage can be set with-limits by a potentiometer in the id circuit of *V_4*. To make this ad-stment, a 0-50 ma. meter is inserted series with the cathode of *V_4*. The annel selector switch is placed at a sition between channels to stop os-lation in the oscillator stage. Con-cts 12 and 13 on the under side of e chassis may have to be jumpered insure a nonoscillatory state. These ntacts are accessible when an npty insert compartment on the um lies under the contacts. A fin-r can then be placed over contacts 12 and 13 as a jumper. If the current rises, keep the jumper in place. Adjust the potentiometer *R_6* for a 28 ma. reading.

The last circuit to be considered in the KRK-12 tuner is the i.f. amplifier. A 43.5 mc. i.f. signal, developed in the mixer stage, is coupled through a wide-band transformer *T_1* to the driven grounded-grid amplifier *V_3*, a type 6BQ7A. The output of the amplifier is coupled through *T_2*, a link coupling transformer, to the i.f. section on the main receiver chassis.

The KRK-22 R.F. Tuner

The KRK-22 (see Fig. 5), like the KRK-11, is a v.h.f. tuner which covers Channels 2 through 13 by means of switching inductances. Electrically, both tuners are quite similar. An elevator transformer, along with i.f. and FM traps, is located in a separate compartment at the rear of the tuner chassis. The r.f. amplifier circuit used is the driven grounded-grid type using a type 6BQ7A. An a.g.c. voltage is applied to this stage to prevent overload of the first i.f. amplifier on strong input signals.

Oscillator and mixer circuits are built around a type 6X8 triode-pentode tube. The pentode section provides increased conversion gain and pre-

(*Continued on page* 51)

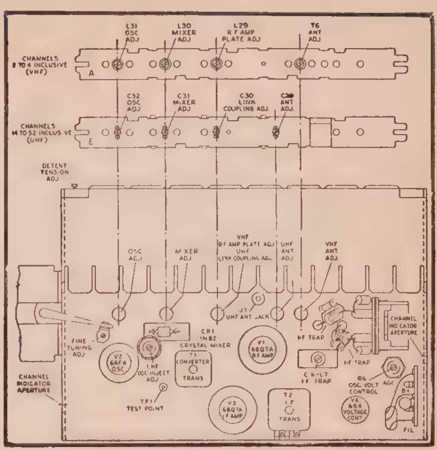


Fig. 2. Top view of the KRK-12 u.h.f.-v.h.f. tuner showing the adjustment points and two typical strip inserts.

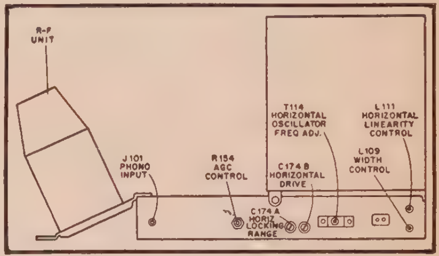

R-F UNIT
T114 HORIZONTAL OSCILLATOR FREQ ADJ.
L111 HORIZONTAL LINEARITY CONTROL
L109 WIDTH CONTROL
J101 PHONO INPUT
R154 AGC CONTROL
C174 B HORIZONTAL DRIVE
C174 A HORIZ LOCKING RANGE

Fig. 3. Rear view of the KCS-82 chassis showing the various rear apron controls.

Fig. 4. Top view of the RCA KCS-82 chassis with the KRK-11 (v.h.f.) tuner.

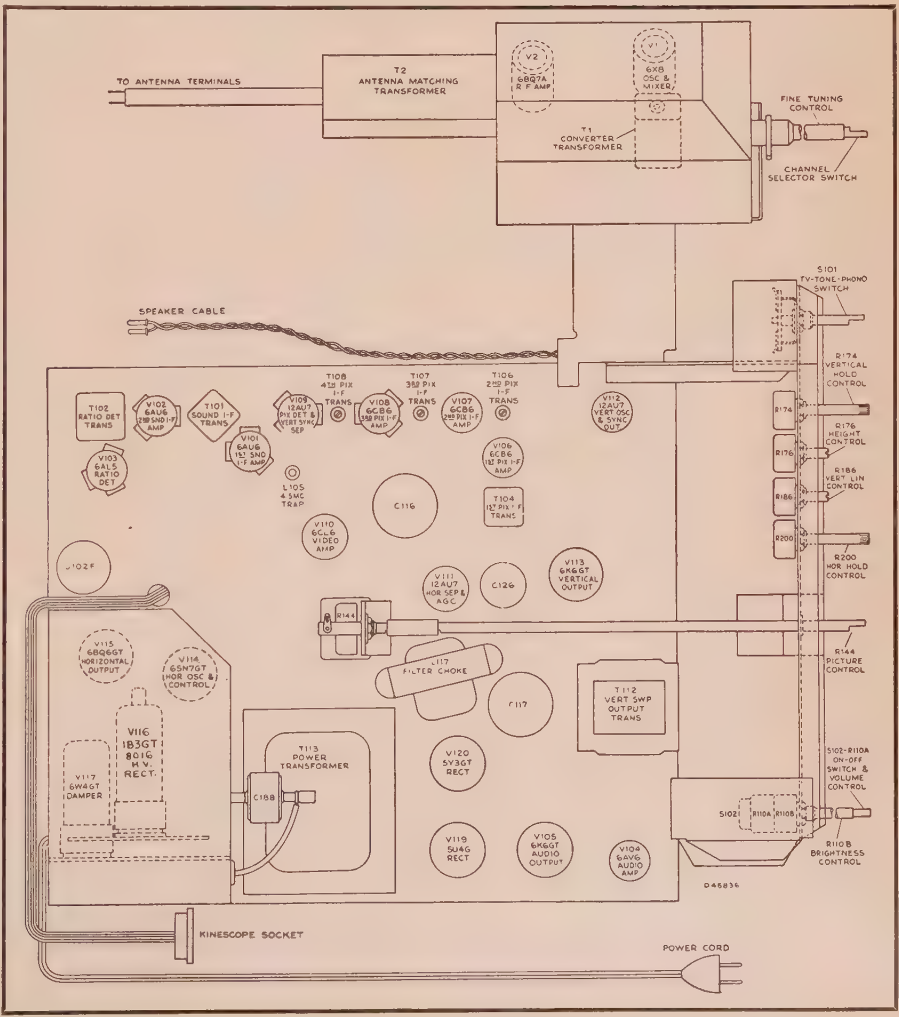
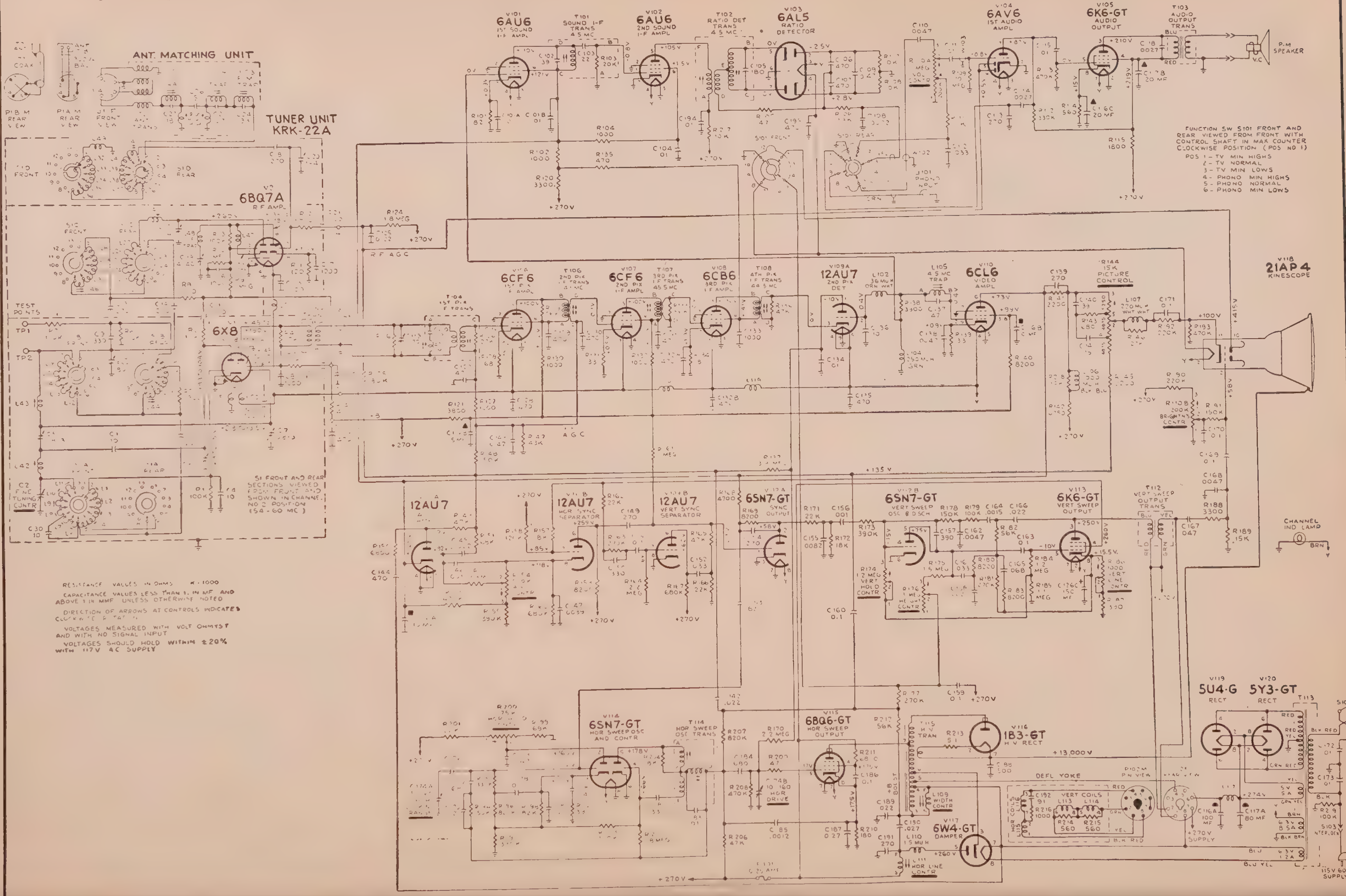


Fig. 5. Complete schematic diagram of the RCA KCS-82 chassis with the KRK-22 v.h.f. tuner. Correct voltage readings for various circuit points are included on the diagram.


ANT. MATCHING UNIT
TUNER UNIT KRK-22A
6BQ7A RF AMP.
6X8
TEST POINTS
TP1
TP2
V101 6AU6 1ST SOUND I-F AMPL.
T101 SOUND I-F TRANS 4.5 MC
V102 6AU6 2ND SOUND I-F AMPL
T102 RATIO DET TRANS 4.5 MC
V103 6AL5 RATIO DETECTOR
V104 6AV6 1ST AUDIO AMPL
V105 6K6-GT AUDIO OUTPUT
T103 AUDIO OUTPUT TRANS
P.M. SPEAKER
RF AGC
AGC
V104 6CF6 1ST PIX I-F AMPL
T106 2ND PIX I-F TRANS
V107 6CF6 2ND PIX I-F AMPL
T107 3RD PIX I-F TRANS 45.5 MC
V108 6CB6 3RD PIX I-F AMPL
T108 4TH PIX I-F TRANS 44.5 MC
V109A 12AU7 2ND PIX DET
L105 4.5 MC TRAP
V110 6CL6 VIDEO AMPL
R144 15K PICTURE CONTROL
V118 21AP4 KINESCOPE
12AU7
V111B 12AU7 HOR SYNC SEPARATOR
V111B 12AU7 VERT SYNC SEPARATOR
V112A 6SN7-GT SYNC OUTPUT
V112B 6SN7-GT VERT SWEEP OSC & DSCH
V113 6K6-GT VERT SWEEP OUTPUT
T112 VERT SWEEP OUTPUT TRANS
CHANNEL IND LAMP
V114 6SN7-GT HOR SWEEP OSC AND CONTR
T114 HOR SWEEP OSC TRANS
V115 6BQ6-GT HOR SWEEP OUTPUT
T115 H.V. TRAN
V116 1B3-GT H V RECT
+13,000 V
V117 6W4-GT DAMPER
DEFL YOKE
V119 5U4-G RECT
V120 5Y3-GT RECT
T113
S102
115V 60~ SUPPLY
+270 V
+135 V

FUNCTION SW S101 FRONT AND REAR VIEWED FROM FRONT WITH CONTROL SHAFT IN MAX COUNTER CLOCKWISE POSITION (POS NO 1)

POS 1 – TV MIN HIGHS
2 – TV NORMAL
3 – TV MIN LOWS
4 – PHONO MIN HIGHS
5 – PHONO NORMAL
6 – PHONO MIN LOWS

S1 FRONT AND REAR SECTIONS VIEWED FROM FRONT AND SHOWN IN CHANNEL NO 2 POSITION (54-60 MC)

RESISTANCE VALUES IN OHMS K = 1000

CAPACITANCE VALUES LESS THAN 1. IN MF AND ABOVE 1 IN MMF UNLESS OTHERWISE NOTED

DIRECTION OF ARROWS AT CONTROLS INDICATES CLOCKWISE ROTATION

VOLTAGES MEASURED WITH VOLT OHMYST AND WITH NO SIGNAL INPUT

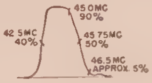
VOLTAGES SHOULD HOLD WITHIN ±20% WITH 117V AC SUPPLY nts local oscillator feedthrough to e i.f. stages. The local oscillator es the triode section in a modified lpitts circuit. The i.f. output of the RK-22 places the picture carrier at .75 mc. and the sound carrier at .25 mc.

I.F. and Video Amplifiers

Three stages V_{106}, V_{107}, and V_{108}, are used for picture i.f. amplification (See Fig. 5). In early production models 6CB6's were used in all three stages. In later production models V_{106} and V_{107} were changed to 6CF6's. Interstage coupling is effected with stagger-tuned bifilar transformers, T_{106}, T_{107}, and T_{108}, which provide almost unity coupling between stages. A high gain is obtained in these stages which improves the noise immunity of the

(*Continued on page* 111)

Table 1. Alignment data for the video and sound i.f. circuits of the RCA KCS-82 chassis.

	VIDEO I. F. ALIGNMENT					
STEP	**SIGNAL GENERATOR FREQUENCY**	**SIGNAL GENERATOR CONNECT TO**	**OUTPUT INDICATOR**	**CONNECT TO**	**ADJUST**	**REMARKS**
1			V.T.V.M.	Junction of R_{147} and R_{148}	Bias to −5 volts	Use 7.5 volt battery with 1000 ohm potentiometer across it. Connect positive battery terminal to chassis, potentiometer arm to R_{147}-R_{148}.
2	44.5 mc. no sweep	Terminals A and B T_{104}	V.T.V.M.	R_{138} and L_{105} junction and to ground	T_{108} for maximum reading	Reduce input signal, if necessary, to produce 3 volts of d.c. at R_{128} and L_{105}
3	45.5 mc. no sweep	Terminals A and B of T_{104}	V.T.V.M.	R_{138} and L_{105} junction and to ground	T_{107} for maximum reading	
4	43.0 mc. no sweep	Terminals A and B of T_{104}	V.T.V.M.	R_{138} and L_{105} junction and to ground	T_{106} for maximum reading	
5	47.25 mc. no sweep	Terminals A and B of T_{104}	V.T.V.M.	R_{138} and L_{105} junction and to ground	T_{104} (top) for minimum reading	
6	For Models 21-T-303U to 21-T-324U inclusive, follow steps above; except, connect signal generator to front terminal of the crystal mixer in series with a 1500 $\mu\mu$fd. ceramic condenser, also turn a.g.c. fully clockwise.					
7	43.5 mc. center freq. 5 mc. deviation	TP_2 in series with a 1500 $\mu\mu$fd. ceramic condenser	Oscilloscope through diode probe	Pin 5 of V_{106} and ground	T_1 (top) and T_{104} (bottom) for maximum, with 45.75 mc. at 70% of maximum response	Use shortest leads possible.
8	Same as above	Same as above	Same as above	Same as above	C_{119} until 42.5 mc. is at 70% response	After adjusting C_{119} remove load resistors.
9	Same as above	Same as above	Oscilloscope	Pin 2 of V_{110}	Retouch T_{106}, T_{107}, and T_{108} to obtain curve below  	Adjust sweep generator to give 3 volts peak-to-peak on oscilloscope. Couple a signal generator loosely to the grid of the first pix i.f. amplifier. Adjust the output of the signal generator to produce small markers.
	For Models 21-T-303U to 21-T-324U inclusive, follow steps above; except, connect sweep generator to front terminal of the crystal mixer, also preset the channel selector to Channel 5.					
	SOUND CIRCUIT ALIGNMENT					
10	4.5 mc.	Pin 1, V_{101}	V.T.V.M.	Pin 2, V_{103}	T_{102} (top) for maximum reading (d.c.)	Adjust signal level on generator for 6 volts when peaked.
11	4.5 mc.	Pin 1, V_{101}	V.T.V.M.	Junction of R_{106} and C_{108}	T_{102} (bottom) for zero reading (d.c.)	
12	Repeat steps 10 and 11					
13	4.5 mc.	Pin 1, V_{101}	V.T.V.M.	Pin 2, V_{103}	T_{101} (top) for maximum reading (d.c.)	
	4.5 MC. TRAP ADJUSTMENT					
14	4.5 mc. in series with a 1000-ohm resistor (modulate 30% with 400 cycles)	Pin 2, V_{109}	Oscilloscope through crystal probe	Pin 6, V_{110}	L_{105} for minimum	Set generator output at .5 volt. Short 3rd picture i.f. grid to ground (pin 1, V_{108}) to prevent noise from masking output indication.

A "MINIMUM" MOBILE

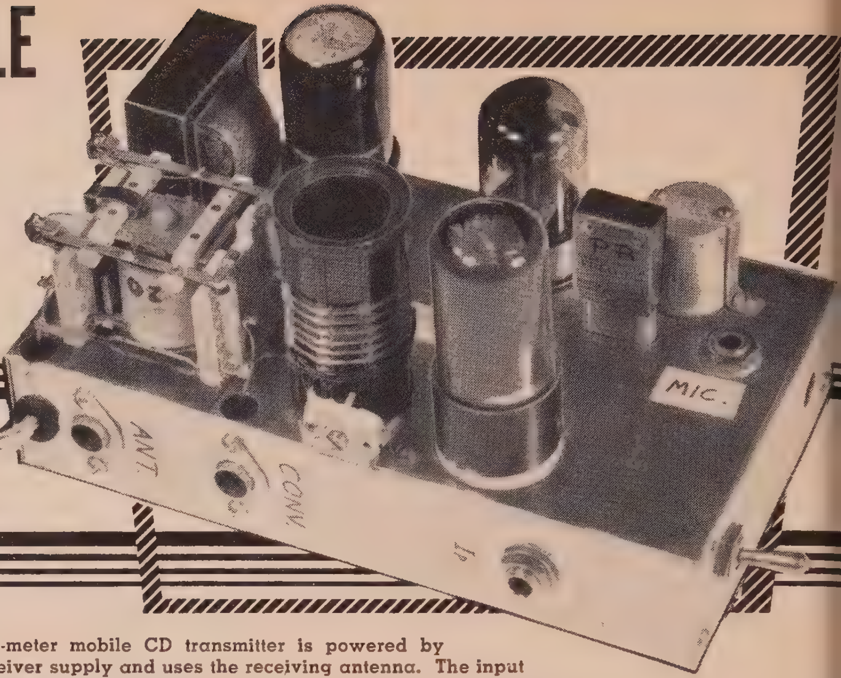
FOR

10-METER CD

By

RICHARD G. FINKBEINER

W8AQK



The 10-meter mobile CD transmitter is powered by the receiver supply and uses the receiving antenna. The input of two watts is adequate for local fixed-to-mobile work, saves battery.

A minimum of cost and complexity are featured in a mobile ten-meter transmitter designed for local CD network use.

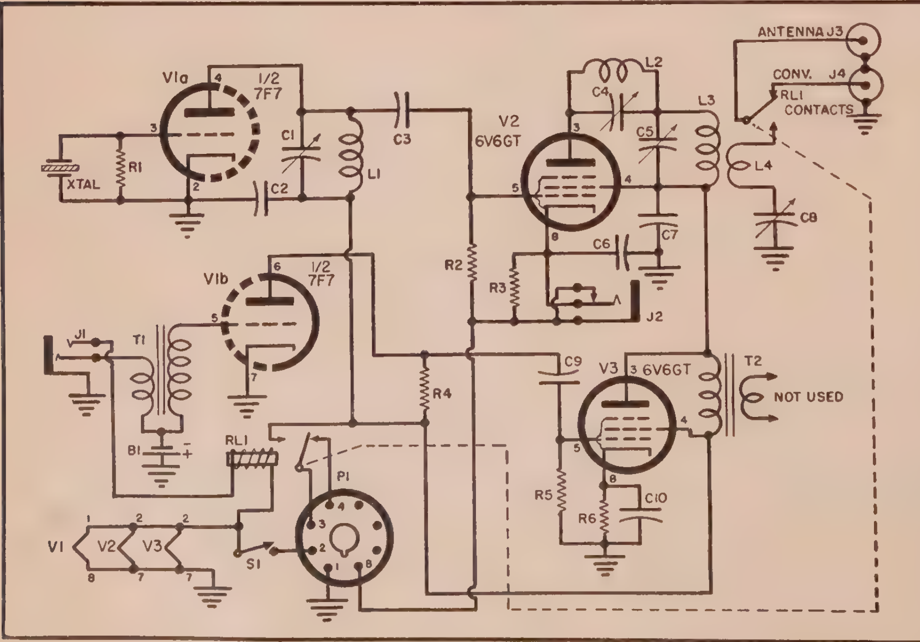
TEN-METER mobile amateur stations form the nucleus of most Civilian Defense networks and in this day and age it is the duty of as many amateurs as possible to take part in CD drills. Many are not participating because of the unusually high cost of equipment and the extensive work required for construction and installation. The purpose of this article is to describe the design of a simple 10-meter mobile station that will enable more amateurs to take part in Civilian Defense activities.

Shown in the photos is a transmitter that requires a minimum of parts for construction and is small enough to fit behind the dash or in the glove compartment of an automobile. A broadcast receiver, *Gonset* converter, and 100-inch side-cowl mounted antenna complete the station. Power for the transmitter is taken from the vibrator supply in the receiver, and the available two-watt final plate input power gives performance on a par with that obtainable from higher-powered rigs. Note that no trunk space, dynamotor, separate antenna, or dash-to-trunk wiring are required. In addition, the battery drain is equal to that of the receiver, a highly desirable feature during emergency operation over a long period of time.

Fig. 1 shows the transmitter circuit. The r.f. portion of the transmitter uses one half of a 7F7 dual triode as a crystal-controlled oscillator operating on twenty meters. L_1, the oscillator plate coil, is 20 turns of No. 22 enamel wire closewound on a ⅝" diameter polystyrene form 1¼" long.

Following the oscillator is a 6V6GT power amplifier doubling to ten meters. L_3, the tank coil primary, is 6 turns of No. 20 wire spaced to ¾"

Fig. 1. Circuit diagram, showing use of ordinary receiving tubes. J_2 is insulated from chassis as the "B-minus" connection was not grounded in power supply (see Fig. 2). If a supply with no bias tap is used, pin 8 of P_1 can be grounded directly.



R_1—10,000 ohm, ½ w. res.
R_2—100,000 ohm, ½ w. res.
R_3—1 ohm, ½ w. wirewound res. (meter shunt type)
R_4, R_5—270,000 ohm, ½ w. res.
R_6—470 ohm, 1 w. res.
C_1—50 μμfd. air trimmer cond.
C_2, C_6, C_7—.01 μfd. disc ceramic cond.
C_3—27 μμfd. tubular ceramic cond.
C_4, C_8—30 μμfd. mica trimmer cond.
C_5—25 μμfd. air trimmer cond.
C_9—.01 μfd., 600 v. paper cond.
C_{10}—10 μfd., 25 v. elec. cond.
J_1—Three-circuit jack (for PL-68 plug)
J_2—Closed circuit jack (insulated)
J_3, J_4—Chassis mounting antenna connectors
L_1—20 t., #22 en., closewound on ⅝" polystyrene form
L_2—3½ t., #20 en., ⅜" dia., ¼" winding length, airwound.
L_3—6 t., #20 en., ¾" winding length, wound on 1¼", 5 prong plug-in coil form
L_4—3 t., #22 en., closewound below "cold" end of L_3 (spaced ⅛" from L_3)
P_1—Octal plug (Amphenol 86-PM8)
RL_1—D.p.d.t. 6 volt d.c. relay
S_1—S.p.s.t. toggle switch
T_1—Microphone to grid trans. (UTC "Ouncer")
T_2—8000-ohm output trans. (see text)
B_1—1½ v. penlight cell
Xtal—Crystal, 20 m.
V_1—7F7 tube V_2, V_3—6V6 tube

1¼″ plug-in coil form. The link s 3 turns of No. 22 wire close- nd next to the "cold" end of the ary. L_4 and C_8 form a series-res- nt circuit to tune out the link tance at the operating frequency permit greater output because internal impedance of the link is retically zero under these condi- s. All traces of TVI are elimi- d by a simple but effective trap, nd C_4, in the 6V6GT plate lead. s 3½ turns of No. 20 enameled , ⅜″ in diameter and ¼″ long. e other section of the 7F7 is used he first audio stage in the modu- r. A T-17 microphone is coupled e grid by a *UTC* "Ouncer" micro- e-to-grid transformer. Both mi- hone current and bias for the are furnished by a penlight cell ch will last its shelf life as only a. are consumed by the micro- ne while transmitting. This cir- keeps vibrator "hash" out of the io circuits, a difficulty often en- tered when trying to use the 6- receiver supply for microphone rent. It also makes a simple bias rce for the 7F7 and eliminates the al cathode resistor and bypass lenser.

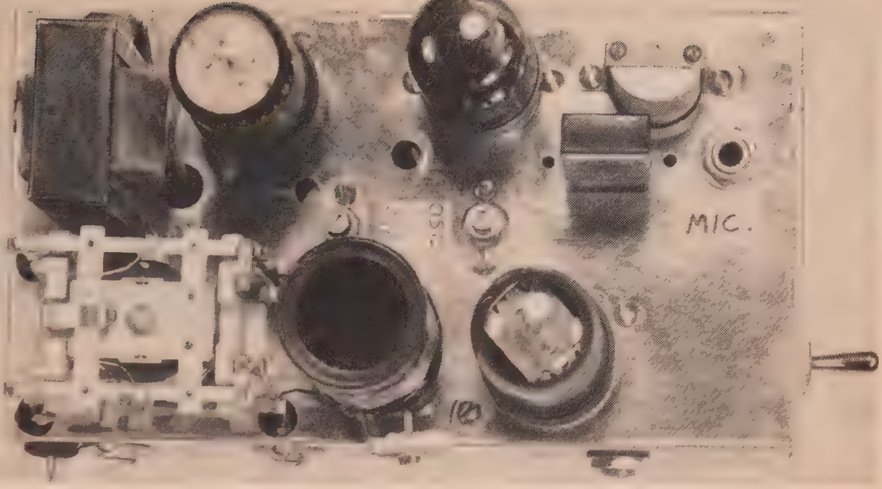
ext in line is a 6V6GT Heising lulator, which uses the primary of replacement type output trans- ner as an audio choke. Any 5000- 10,000-ohm plate-to-voice-coil nsformer will work, although the ginal was an 8000-ohm unit with -watt power rating.

oth octal and loctal tubes were d in the original model simply be- se they were available in the nk box". As direct substitutes for 7F7, a 6SL7 octal or 12AX7 mini- re type may be used. Also, a 7C5 al or 6AQ5 miniature can be sub- uted for the 6V6GT's.

wo power sockets are added to the eiver as shown in Fig. 2A, the par- schematic of a typical auto radio ver supply. A three-prong *Jones* ket supplies 6 volts and "B" volt- from the second filter section to converter, while the octal socket ries power to the transmitter. nt "X" is broken so that the trans- ter relay may be connected to nsfer "B" voltage between the re- ver and transmitter. Wire the 6 lead to the "hot" heater pin of tube in the receiver except the tifier; otherwise vibrator "hash" get into the converter *via* the ter wiring.

he cathode and grid returns of the GT doubler-final stage are con- ted to the "B-minus" lead in the eiver power supply so that the hest possible "B" voltage will be ilable. A voltage of 120 to 150 s (from standstill to maximum erator charge) was available from *Motorola* model 251 receiver used the original installation. Many eivers do not have a bias tap in power supply and the "B-minus" nection is grounded. In such a

(*Continued on page* 121)



Top view, showing relay and modulator choke at left. The 6V6's may be replaced by 7C5's or 6AQ5's, and the 7F7 oscillator-speech amplifier by a 12AX7 or 6SL7 tube.

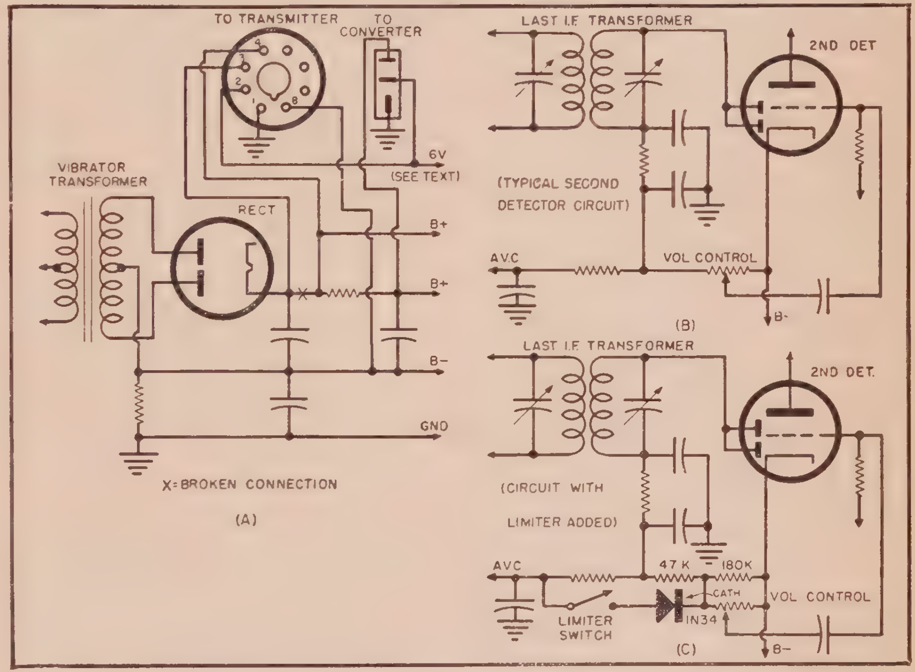
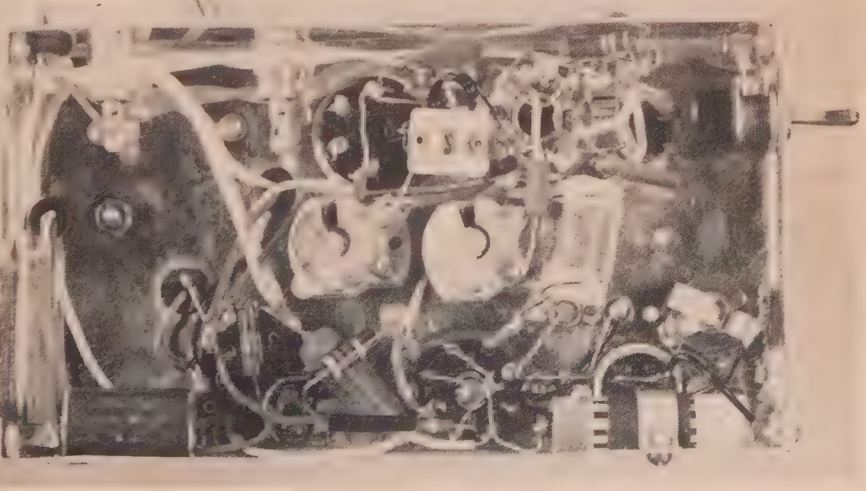


Fig. 2. Modifications of the receiver. (A) An octal socket and 3-prong connector are added to the power supply. Broken connection (X) permits switching power from receiver to transmitter through relay. (B) and (C) show addition of noise limiter.

Bottom view. The TVI-trap L_2C_4 is visible at top center. C_4 is adjusted through a small hole in bottom plate. The "penlight" cell for microphone is at lower right.



FASTER TV SERVICING

THROUGH CIRCUIT TRACING

By **MILTON S. KIVER**
Pres., Television Communications Institute

Cut down service time and increase your profits by using these recommended techniques for locating receiver faults.

ONE of the greatest difficulties that faces many technicians is the tracing of specific circuits through the complex maze of lines that one finds on a television schematic diagram.

You are given a defective television set to service and by examining the symptoms, you form an idea of where the trouble lies. But you're not sure. So the first thing you want to do is see what sort of a signal the suspected stage is receiving from a previous section. But this means tracing back through the circuit and if you are weak on circuit tracing you can easily take half an hour to do a 5-minute job. In your own shop, this means less money. If you are working for someone else, the impression you convey is not favorable. Neither prospect is desirable.

Now, how do you become proficient in circuit tracing? First, by learning as much as you can about the operation of the various circuits in a television receiver. Second, by becoming familiar with the place each stage has in the over-all television schematic. Third, by practicing circuit tracing every chance you get.

In the present article, little can be done to help anyone overcome deficiencies in the first two categories. In every issue of this magazine the reader will find numerous circuit explanations and he is strongly urged to read them. To acquaint yourself with the position and operation of the various stages in a television receiver, reference may be made to any of the textbooks on the market, such as the author's "Television Simplified".

Where we can be of service, however, is with regard to the third point, namely, helping you trace your way through a television schematic. In the allotted space of one article it is impossible to consider every aspect of a television receiver. So, we shall concentrate on the "B+" lines that power the various sections of a television receiver.

The d.c. power supply is the common denominator for the entire television receiver. There is hardly a circuit in the set to which it does not supply power and what befalls the power supply will affect every stage of the receiver. By the same token, it is entirely possible for a defect in one stage to be reflected, in some way, in one or more of the other stages. Thus, a shorted condenser in one section of a set can so load down the power supply that it renders the entire receiver inoperative.

Now to get down to brass tacks with an actual service problem. A *Zenith* Model K2229E television receiver was brought into the shop with the complaint of very weak sound and no picture or raster. The combination of weak sound and missing raster immediately suggested a defective "B+" and subsequent measurements bore this out because the "B+" voltage on a number of tubes was low.

The problem then was straightforward: Something was placing so much of a load on the power supply that the voltage was being lowered. The culprit could be a tube, a condenser, or a resistor. (There might be other unusual circumstances but in servicing, like poker, you play percentages first if you want to win.)

The ferreting out of the defective component in a situation like this can be rugged, as any technician who has been faced with a similar problem can tell you. In essence, you are looking for one component out of several hundred and this could easily take half the night unless you know what you are doing.

As a first step, let us take out the schematic diagram of the set and study it for a minute. See Fig. 1. The power supply is transformer coupled to the a.c. line and, as is usual in such instances, the tube heaters are wired in parallel. This means we can remove one tube without affecting any of the others as far as heater power is concerned. The d.c. voltages supplied by the 5U4G rectifier are +250 volts and +150 volts. As far as we can tell, these are the only two d.c. voltages utilized in this receiver. However, it is entirely possible that subsequent voltage divider networks elsewhere in the receiver do produce other values of d.c. voltages which are used by a number of stages. This is a common practice and therefore is a definite possibility that must be considered.

The next step in tracking down the defect is to determine in which of the lines radiating from the power supply it exists. Let us consider the 150-volt line first. This starts at point *J* and travels to the right and then up until it reaches point *K*. At this point one line travels off to the right, eventually supplying voltage to the screen and plate of V_{11}, the 6BE6 sync clipper. Of interest, too, along this path is the bridging of the brightness control from the 150 volts to ground.

Disconnect this line at point *K* and see if the voltages in the rest of the set return to normal. Here it did not, so we knew that the trouble, whatever it was, did not exist in this branch of the "B+" network and the wire was resoldered to its terminal.

Returning to point *K*, the 150-volt line moves straight up to point *L* and to the right. See Fig. 1. Here we find: V_5 (6CB6) 3rd video i.f.; V_{6A} (1/2 6U8) screen grid of 1st video amplifier; V_{6B} (1/2 6U8) sound amplifier; V_7 (6BN6) screen grid of audio detector; and the fringe-lock potentiometer.

Disconnect this line and again see whether the "B+" voltages in the rest of the set return to normal. Still no luck here so the trouble must lie elsewhere.

We have now completed tracking the +150 volt line. The next step would be to return to the power supply and see what success we have with the 250-volt line. This line starts at point *A* just beyond filter choke T_9. At point *A* the line branches off in several directions and these are best considered one at a time. Moving from *A* to the right we reach point *B*. From point *B*, follow the line down to point *C* and thence to the right. At point *D* we see that the 250 volts feed the screen grid of V_{15}, the 6BQ6GT horizontal output amplifier. Beyond point *D*, the 250-volt line enters the damper circuit where it is combined with the boost "B+" to provide an increased voltage of 430 volts here. This boosted "B+" then takes care of the plate of the 6BQ6GT and several other stages, as we shall see presently.

(*Continued on page* 56)

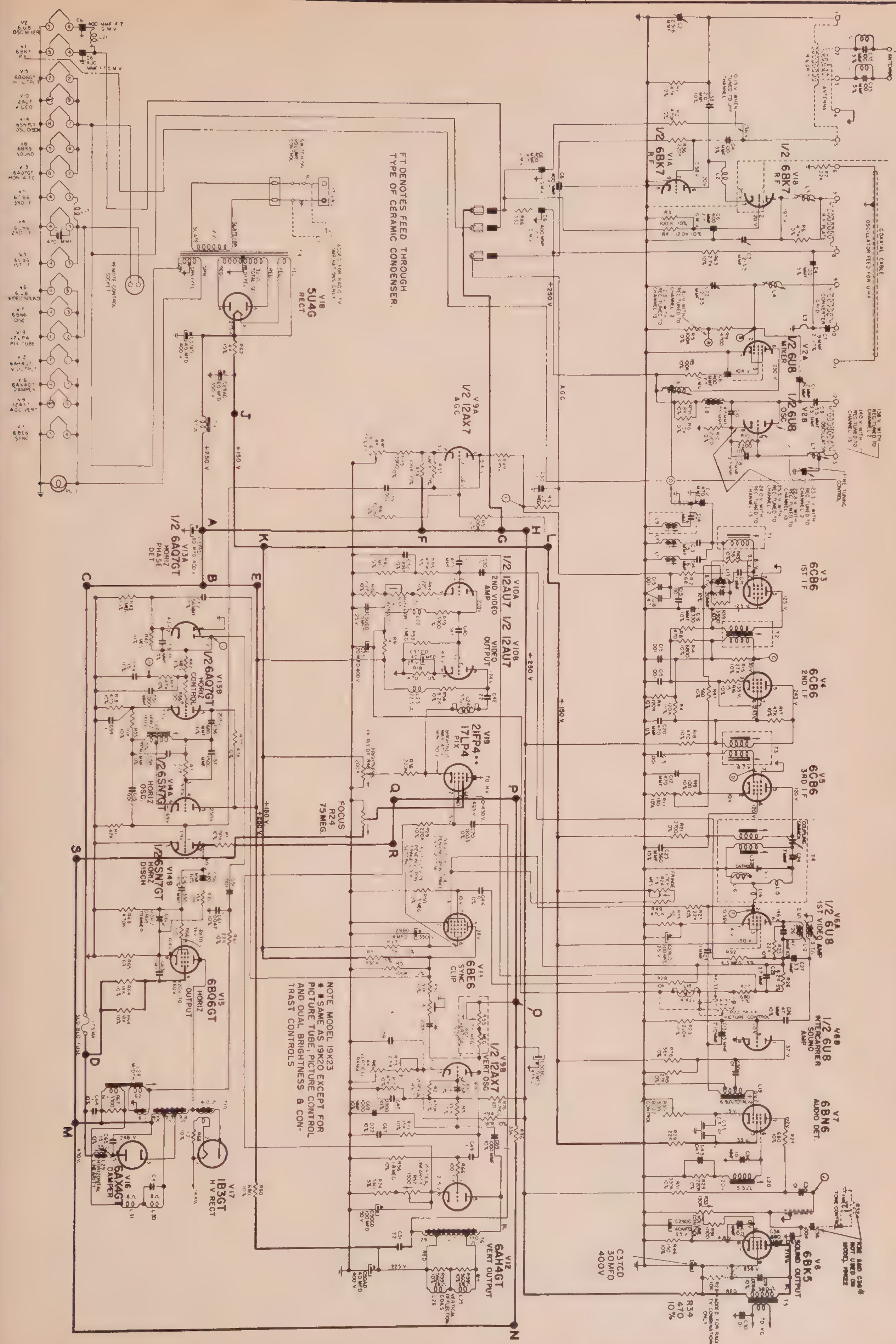


Fig. 1. Schematic of Zenith's Chassis 19K23. See text for explanation of circuit tracing this and similar TV sets.

F.T. DENOTES FEED THROUGH TYPE OF CERAMIC CONDENSER.

NOTE MODEL 19K23 ** SAME AS 19K20 EXCEPT FOR PICTURE TUBE, PICTURE CONTROL AND DUAL BRIGHTNESS & CONTRAST CONTROLS

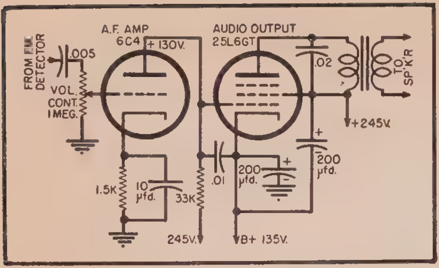


Fig. 2. Schematic of the Hallicrafters audio amplifier circuit showing how the 25L6GT control grid gets its correct bias.

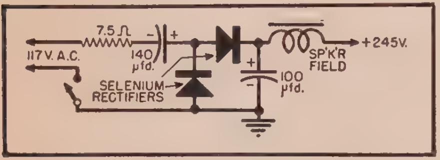


Fig. 3. Power supply of the Hallicrafters Model 1010P receiver. The filaments of the various tubes are series-parallel connected and are not shown on this schematic.

Following the procedure outlined previously the line leading from *B* to *C* to *D* was disconnected and again the voltage in other sections of the set was tested with no change in conditions. In other words, the trouble still persisted.

Returning to point *B*, let us move on to *E* and thence to the right. Here we find the following stages connected into the 250-volt line (in the order in which they tap off of the line): V_{10A} (1/2 12AU7) 2nd video amplifier; V_{10B} (1/2 12AU7) video output; V_{13B} (1/2 6AQ7GT) horizontal control tube; V_{14A} (1/2 6SN7GT) horizontal oscillator; and V_{12} (6AH4GT) vertical output.

Nothing was achieved in this branch either (by the same disconnecting technique) so we returned to point *A* again and followed the 250-volt line upward to points *F*, *G*, and the circuits into which they connect. At point *F* the line connects into the cathode of the a.g.c. tube and from here through a series circuit to ground. At *G* the line branches off to the left where it supplies voltage to all the stages (r.f. amplifier, mixer, and oscillator) of the tuner.

Beyond *G* to *H* and off to the right we find the following stages connecting into the 250-volt line: V_4 (6CB6) 2nd video i.f. (and V_3 through V_4. These two tubes are in series); V_{9B} (1/2 12AX7) grid and cathode of vertical oscillator; V_7 (6BN6) plate of audio detector; and V_8 (6BK5) sound output.

In the line which branches off to the right at point *H* we strike pay dirt because disconnecting this line brings the rest of the set voltages back to normal. Somewhere along here, then, must lie our source of trouble and it turns out to be C_{37CD}, a 30-µfd. filter condenser. This is evidently leaky, drawing an excessive current through R_{34}. The latter resistor is charred and had the set been kept on much longer it would undoubtedly have burned out.

As stated previously, the procedure for isolating this particular trouble was straightforward but the technician had to be capable of tracing the "B+" voltage distribution through the receiver. This was done here in some detail to show how it would be carried out. (Some men may be able to figure out a somewhat faster way of tracking down this defect. The longer route was taken purposely to demonstrate all the steps.)

Mention was made previously of the boosted 430 volts and it might pay us to examine this section of Fig. 1 because boost "B+" circuits always prove confusing. In the *Zenith* set, the boost "B+" can be considered as starting at point *M*. This is located just below the damper tube. One line from point *M* goes to the right and up to point *N*, and then to the left, where we find the plate of V_{9B}, the vertical oscillator, tied in at point *O*. Beyond *O*, there is point *P* and from here to the first anode of the picture tube.

Also tied into the same line, *via Q* and *R*, is the plate of V_{14B}, the horizontal discharge tube.

To complete the distribution of the boosted "B+" voltage, return to point *M* and then move to the left. This will take you to point *S* and up to the focus potentiometer, R_{21}. The focus electrode of the picture tube feeds off the center terminal of this control.

To some technicians the *Zenith* diagram might seem to present a fairly complex arrangement and yet in comparison to other sets which he will encounter, this is a comparatively simple distribution system. The paths of the various voltages were clearly defined and could be followed without too much difficulty. Just remember to start at the d.c. supply and to follow each branch out to its end. Then return, and do the same for each subsequent branch. Do not, at any time, go through any condensers or other components which break the d.c. path required for the transmission of this voltage. Resistors, of course, serve only to decrease the voltage. They do not ordinarily stop it.

Of increasing interest in recent television receivers has been the use of tubes in series-parallel arrangements across the power supply. The power supply in Fig. 3 is taken from one such receiver (a *Hallicrafters* Model 1010P) and its output voltage is seen to possess a single value, namely + 245 volts. However, if you were to examine the remainder of the receiver schematic carefully (not shown here), you would find that a number of tubes tap into a + 135-volt line. The question is, where did that 135-volt line come from?

The answer is to be found in the manner in which the various tubes are connected across the power supply. Some stages are powered by the 245-volts directly and, of course, there is no difficulty here. But if we examine the + 135-volt line, we see that it is obtained from the cathode of the audio output tube, a 25L6GT. What happens is that 245 volts is applied to the plate circuit of the 25L6GT. Of this, 110 volts is dropped across the tube, leaving 135 volts at the cathode. It is this 135 volts which is then applied to a number of other stages in the receiver. Thus, the 25L6GT audio amplifier is in series with the parallel combination (here) of nine stages. See Fig. 4. All of the series current passes through the audio amplifier tube, but this tube is ordinarily designed to handle such large currents. The remaining tubes in the bottom half of this string are in parallel with each other and they merely divide up the series current as they need it.

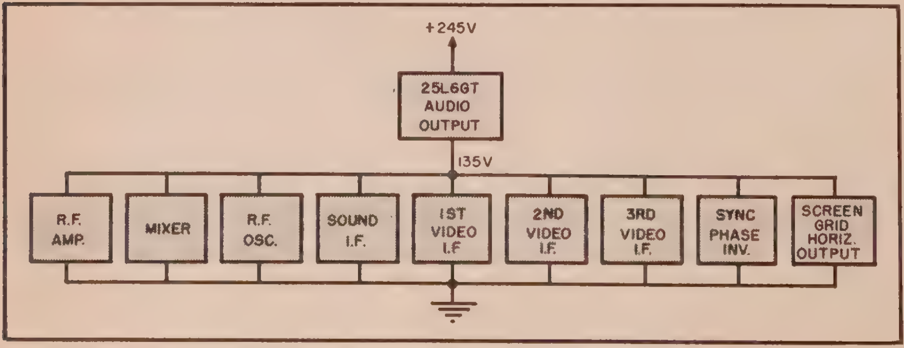
One consequence of this type of arrangement is the fact that since the cathode of the audio amplifier is positive (here by 135 volts), the control grid of this tube must also be made positive, although by a somewhat smaller value. The grid of the 25L6GT connects directly to the plate of the preceding 6C4 audio amplifier, receiving through this connection a positive voltage of 130 volts. See Fig. 2. Thus, the grid is 5 volts negative with respect to the cathode, providing the tube with its necessary bias.

It is interesting to note that using tubes in the manner shown in Fig. 4 leads to many defect indications which differ from those obtained in a more conventionally designed receiver. Thus, a failure of the audio amplifier tube to conduct will remove sound and picture and raster from the set. The raster disappears because the screen grid of the horizontal output tube connects into the 135-volt line.

In the ordinary receiver, disappearance of sound, video, and raster could mean only one thing—trouble in the

(*Continued on page 68*)

Fig. 4. The arrangement in the Hallicrafters Model 1010P receiver by which tubes are employed in a voltage divider network. See Fig. 3 for additional information.



THE OSCILLOSCOPE AS AN A.C.-D.C. VOLTMETER

By

WALTER H. BUCHSBAUM

Television Consultant
RADIO & TELEVISION NEWS

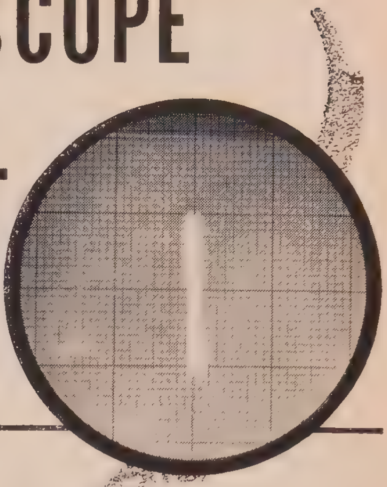


Fig. 1. Scope pattern obtained when horizontal scope gain is reduced to give only narrow vertical strip.

Increase the usefulness of your scope by calibrating it to operate as a peak-reading, high-impedance v.t.v.m.

IE oscilloscope can be a very use- ul, all around instrument in TV ervicing, if its capabilities are y exploited. Most technicians use align television r.f. and i.f. stages, onjunction with a sweep frequency erator, or else they use it to trace als through various stages. While e are more or less standard appli- ons for the oscilloscope, there are e other useful ways in which the e investment in the scope can be le to pay. For example it is pos- e to use an oscilloscope as a volt- er to measure a.c. or d.c.

D.C. Voltage Measurement

ith no signal applied to the ver- l scope terminals the horizontal produced by the horizontal scope ep depends for its position on the ing of the vertical centering con- . If a sudden voltage is applied to vertical input terminals, the line ps up or down, depending on the arity of the input voltage. Try this connecting the negative terminal of attery, any voltage you happen to e handy, to the scope ground and touch the positive terminal to the gh" side of the vertical input ter- als. If the line moves off the een, reduce the vertical scope gain. he line moves very little, increase vertical gain. You will observe t after reaching a certain height line will move back again to its ginal position. Some oscilloscopes e a switch permitting connection a d.c. amplifier or a direct connec- to the vertical deflection plates in these scopes the line will not urn to the base, but remain at the height. To use the scope as a tmeter it is very helpful if a grid nted on transparent plastic is ced in front of the CR tube. This l can then be used as a reference checking the location of the base . A red or black grease pencil or yon is often used to mark the am- ude of a signal on the scope een. The system for measuring d.c. tage on the scope makes use of the ne phenomenon as observed with battery experiment. A d.c. volt- will deflect the electron beam in ect relation to its amplitude. If 1 t moves the beam two grid divi- ns, 10 volts will move it 20 divi- ns. All that is needed now is a erence or calibration voltage and n, by comparison, we can measure voltages directly.

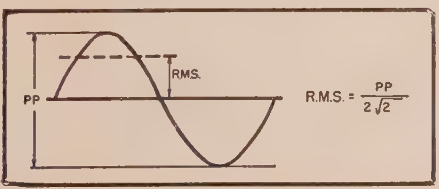
ecause most scopes use a series denser in the input circuit, the d.c. tage applied is not in its entirety pled to the scope amplifier and the y effect on the CRT is the motion the line up and down as the con- nser is charged and then discharges ough the grid resistor. In d.c. volt- measurements it is therefore essary to observe how far from the e the line travels during the charge. calibrating purposes it is best to ch the battery voltage in the same arity as the voltage to be measured. a grid bias is measured, for example, connect the negative battery terminal to the "high" side and the positive to ground. For positive voltages, reverse the connections. Whenever possible the battery voltage should be of the same order of magnitude as the voltage to be measured. Errors may result when a 1.5 volt battery is used to calibrate a scope for measuring 500 volts. In such cases the vertical scope attenuator switch can be used to change scales, but this is not always accurate.

R.M.S.	PEAK-TO-PEAK
.35	1
3.54	10
6.3	17.8
100	282
110	310
117	330
125	352

Fig. 2. Most commonly used peak-to-peak voltages and their equivalent r.m.s. values.

To perform a typical measurement like checking the cathode bias voltage of the horizontal output amplifier, the scope is first calibrated. Using a 3-volt battery we adjust the vertical gain control until the connection of the battery raises the line by six grid divisions. Now we know that 1 volt will deflect the line two divisions. When we connect the vertical scope terminals to the cathode and ground in the TV set we find that the line jumps up to 19 divisions from its base position. This means that the voltage at the cathode is 9.5 volts. In a similar manner any voltage up to about 600 volts can be measured with the scope. The 600-volt limit applies to most scopes and is based on the voltage rating of the input condenser and the limits of the vertical scope attenuator.

Fig. 3. Peak-to-peak vs. r.m.s. values.



A.C. Measurements

Most a.c. voltmeters are only good for measuring the r.m.s. voltages of sine waves, although some have peak reading scales, also limited to sine wave signals. To measure the peak value of any other a.c. signal, the simplest instrument is the scope.

Actually the scope can be used to measure all a.c. voltages, peak or r.m.s., with greater accuracy than most reasonably priced voltmeters. The principle used in a.c. measurements is the same as in d.c., but here the input condenser of the scope is no longer an obstacle to the signal so that more accurate and readable measurements result. By connecting the signal under test to the vertical scope terminals, its amplitude, as well as waveshape, can be observed and measured clearly.

The source for calibrating the scope for a.c. is often built into the scope and available at a test jack on the front panel. While the voltage varies with different scopes, most service equipment uses 6.3 volts as the test signal. 6.3 volts is the r.m.s. value

(*Continued on page* 88)

A LOW DISTORTION AUDIO SIGNAL GENERATOR

The author's low-distortion signal generator. Circuit improvements, described in the text, provide better performance than is usually found in home-built gear.

By
GEORGE ELLIS JONES, JR.
Dept. of Chemical Engineering
University of Pittsburgh

A distortion figure of less than one-tenth of one per-cent and an output flat within ± 1 db in this generator assure accurate checking of critical amplifier characteristics.

ALTHOUGH a number of Wien bridge type audio signal generators have been described in the literature, the majority have one serious weakness. They produce too much distortion to be used successfully for making harmonic distortion analysis on good audio amplifiers. If the amplifier under test produces, say, 1% distortion and the signal generator's output itself contains 1% distortion, analysis of the amplifier's performance is practically impossible. The amplifier output might, under these circumstances, contain anything from zero to two per-cent distortion. The exact value would depend upon whether the two distortions interacted to cancel or to augment each other. These deficiencies in these typical generators prompted this author to develop a better-than-average Wien bridge oscillator subject, however, to the practical limitation that it could be built from commonly available circuit components.

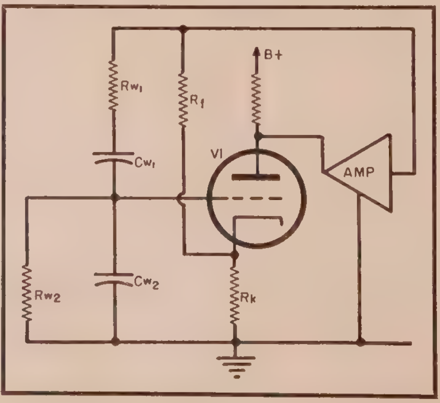
This signal generator covers a range from 11 cycles-per-second to 120,000 cycles-per-second in four overlapping ranges. Its output is flat within ±1 db, being one-tenth of a watt into a 600-ohm load from a 600-ohm source. This maximum level amounts to +20 db or 7.74 volts r.m.s. From 70 to 50,000 cps the distortion is less than one-tenth of one per-cent. Hum and noise are 20 db further down.

A simplified diagram of this oscillator is shown in Fig. 1. The amplifier, indicated by the triangular symbol, yields 180° of phase shift so that the grid of V_1 is driven by a regenerative feedback loop while the drive at the cathode is degenerative. This regenerative loop, produced by the Wein bridge, is frequency-selective. Through it a maximum transmission ratio of 1:3 exists at a frequency, f_o, given by the equation:

$$f_o = 1/2\pi RC$$

where: $R_{w1} = R_{w2} = R$
and $C_{w1} = C_{w2} = C$

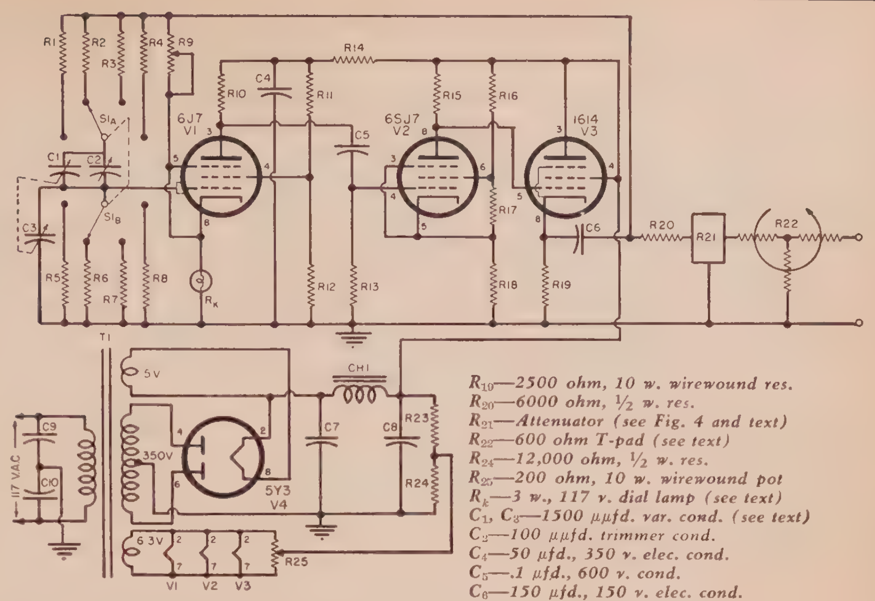
Fig. 1. Simplified diagram of the oscillator circuit. Function of phase-shift amplifier (triangle) is explained in the text.



At frequencies other than f_o the transmission will be less.

If the gain from the grid of V_1 with respect to the output equals or exceeds three, the unit will oscillate at a frequency determined by f_o. If the gain is greater than three, the amplitude of the output will build up until the amplifier circuits are overdriven into a region of grossly non-linear operation. This produces, on the average over a cycle, an effective gain of about three and an extremely poor output waveform.

To prevent this distortion, amplitude limiting in the region of linear operation is provided by the negative feedback loop. The negative feedback factor (essentially the ratio of R_k to R_f) is dependent on the output-signal amplitude. The cathode resistor, R_k, is an incandescent lamp bulb. As it gets warmer when the power it dissipates increases, its resistance increases. The power dissipated in this cathode resistor consists of two parts, one from the quiescent current of V_1 and the other from the current flow produced by the output voltage signal impressed across R_f in series with R_k. Any increase in output signal level causes R_k to warm up, increasing its resistance, and thereby increasing the amount of negative feedback. The effective gain from the grid of V_1 to the amplifier output is therefore reduced. In a comparable manner a reduction in output signal level will produce an increase in effective gain. The key to this see-saw situation is the proper adjustment of R_f. This feedback resistor is set so that an output signal level will be maintained, not by driving the amplifier into nonlinear operation, but rather by the compensating effects of the resistance variation in R_k. Any tendency for the output signal level to change will be reduced by the attendant changes in R_k. This negative feedback loop therefore holds the output level substan-



R₁, R₅—10 megohm, ¼ w. res. ± 1%
R₂, R₆—1 megohm, ¼ w. res. ± 1%
R₃, R₇—100,000 ohm, ¼ w. res. ± 1%
R₄, R₈—10,000 ohm, ¼ w. res. ± 1%
R₉—5000 ohm pot
R₁₀, R₁₂, R₁₅, R₁₆—47,000 ohm, 2 w. res.
R₁₁, R₂₃—100,000 ohm, 1 w. res.
R₁₃—1 megohm, ½ w. res.
R₁₄—56,000 ohm, 1 w. res.
R₁₇—27,000 ohm, 1 w. res.
R₁₈—220 ohm, ½ w. res.
R₁₉—2500 ohm, 10 w. wirewound res.
R₂₀—6000 ohm, ½ w. res.
R₂₁—Attenuator (see Fig. 4 and text)
R₂₂—600 ohm T-pad (see text)
R₂₄—12,000 ohm, ½ w. res.
R₂₅—200 ohm, 10 w. wirewound pot
Rₖ—3 w., 117 v. dial lamp (see text)
C₁, C₃—1500 µµfd. var. cond. (see text)
C₂—100 µµfd. trimmer cond.
C₄—50 µfd., 350 v. elec. cond.
C₅—.1 µfd., 600 v. cond.
C₆—150 µfd., 150 v. elec. cond.
C₇—16 µfd., 450 v. elec. cond.
C₈—100 µfd., 450 v. elec. cond.
C₉, C₁₀—.05 µfd., 400 v. cond.
T₁—Power trans. 350-0-350 v. @ 90 ma.; 5 v. @ 2 amps.; 6.3 v. @ 3 amps.
CH₁—10 hy., 75 ma. filter choke
S₁—D.p. 4-pos. rotary sw.
V₁—6J7 tube
V₂—6SJ7 tube
V₃—1614 or 6L6 tube
V₄—5Y3 tube

Fig. 2. Circuit diagram of the audio generator. R_k is a 117-volt, 3-watt pilot lamp (see text). Circuit of R_{21}, the stepped attenuator, is in Fig. 4. Note the use of a cathode follower driven by a voltage gain pentode, instead of the usual power tube.

y constant despite: (a) tube de-oration; (b) supply voltage varia-; (c) change of amplifier gain with uency, and; (d) mis-tracking of Wien bridge elements as the bridge uned from one frequency to an-r.

nfortunately the impedance pre-ed by the negative feedback loop he amplifier is rather low (about to 4000 ohms) and the voltage which it must be driven is rather (about 20 volts r.m.s.). The low edance is mandatory because the l impedance of the feedback loop t be about three times the resist-of the cathode bias resistor, R_k. ig less signal to drive the feedback results in drift in the oscillator out level. The development of 20 s across 3000 ohms does not sound much of a problem, unless you t to do it with a single ended-e and end up with less than one-h of one per-cent distortion. How-, given enough gain inside the back loop, the degenerative feed-k loop will assume the extra re-sibility of cleaning up the ampli-output stage. Since a regenerative back loop is also involved, the ortion reduction produced by the ative feedback is not so great as ht be expected. This can be dem-rated mathematically.

or the fundamental frequency, f_o, distortion reduction is zero; and the second harmonic it is less than of what might have been ex-ed. It is this loss of feedback the fundamental that causes generators to lock in on various monics of the power supply fre-ncy.

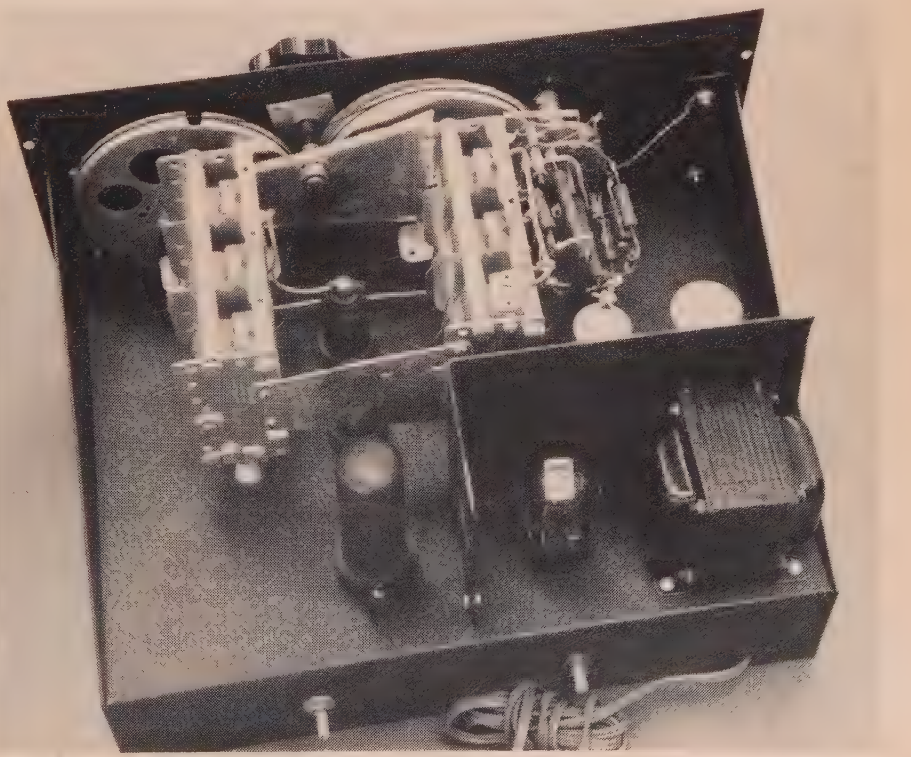
t low frequencies yet another diffi-y arises. The lamp, R_k, itself pro-s distortion. The power dissipated he lamp varies over a cycle of out voltage. The lamp can and warm up and cool down during time of a low-frequency cycle. varies the amount of feedback distorts the output signal. During ositive half-cycle the lamp in-ses in resistance, the feedback or goes up, the effective gain es down, and the waveform is pressed. On the negative half of cycle the waveform is expanded. disfigurement is essentially sec-harmonic distortion, generated in edback loop component as a varia-in the amount of feedback. No gn for increased gain of those ele-ts circled by the feedback loop in any way reduce the resulting ortion.

ne isolating amplifier used to sep-e the oscillator proper from the erator output in most units is an tional source of hum, noise, and ortion. By eliminating this buffer unwanted signals it produces are eliminated. Unfortunately using oscillator output stage for the erator output point places an addi-al load on that stage and increases listortion product.

ypical Wien bridge oscillators employ either a power pentode or a beam tetrode for the amplifier section. This generator uses instead a voltage-gain pentode driving a cathode follower. The cathode follower is a triode-connected beam power tube. The amplifier section has a gain of about 35 instead of the more typical figure of two or three found in the usual generator. Feedback inherent in the cathode follower yields an amplifier section with greater gain and less distortion even before the application of over-all negative feedback.

The actual schematic diagram of the generator is shown in Fig. 2. A

Top view of the low-distortion audio signal generator, showing roomy parts layout.



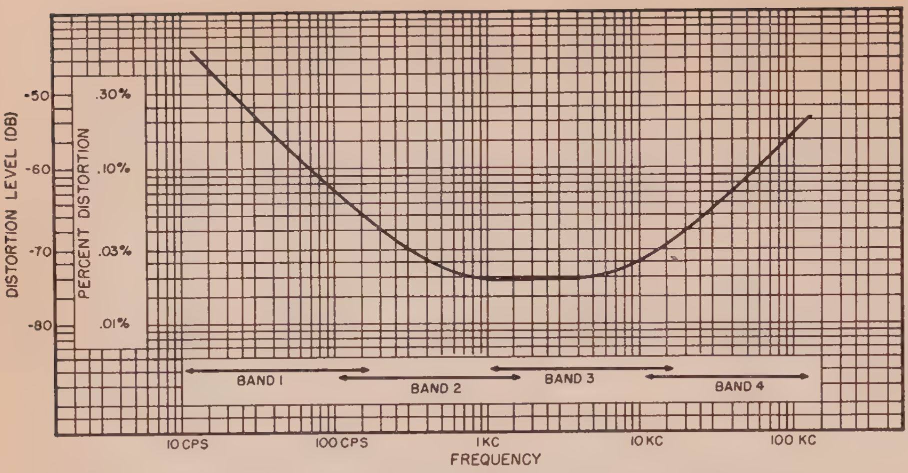
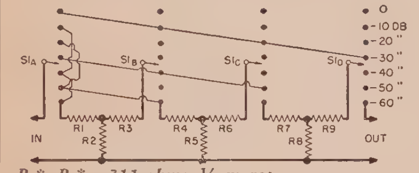


Fig. 3. Harmonic distortion and noise measurement of the audio signal generator. The measurements are valid for all levels including maximum output of 0.1 watt into a 600-ohm load. Residual distortion is 0.02%; rise at ends is discussed in text.



R_1, R_3*—311 ohms, ½ w. res.*
R_2—422 ohms, ½ w. res.
R_4, R_6*—491 ohm, ½ w. res.*
R_5—121 ohm, ½ w. res.*
R_7, R_9*—573 ohm, ½ w. res.*
R_8—38.4 ohm, ½ w. res.*
S_1—4-pole, 7-pos. shorting-type rotary sw.

** See text. Values must be within ± 1%.*

Fig. 4. Circuit of attenuator, R_{21}, Fig. 2.

6J7 tube was used for V_1 because of the grid cap construction. The amplifier section consists of a 6SJ7 and a 1614 (or 6L6). A group of 600-ohm *T*-pads, isolated from the 1614 cathode by a 600-ohm resistor, is connected to the output terminals through a continuously variable 600-ohm *T*-pad. Three fixed pads of 10, 20, and 30 db attenuation are used. Resistance values to the nearest ohm are indicated both in the parts list and in Fig. 4 which shows the fixed attenuator wiring in schematic detail. The author constructed his own pads using a variety of ½ watt composition resistors. These resistors were selected to give the desired attenuation and approximately the desired impedance. From experience it is recommended that a decade attenuator be purchased unless solving puzzles with a resistance bridge is appealing.

The tuning condensers were constructed by bolting together two three-gang 500-$\mu\mu$fd.-per-section tuning condensers with brackets of sheet aluminum (see photographs). Since the rotors are thereby electrically connected they must be wired to the grid of V_1. The entire assembly is mounted on ceramic stand-off insulators to insulate it from the chassis. On each condenser shaft a large dial wheel is mounted. These wheels are interconnected and driven by a dial cable, several turns of which wrap around a ¼″ insulated shaft. This control shaft revolves in two panel bearings, one in the front panel and the other in the aluminum bracket holding the condenser frames. This construction may be seen in the photographs. An indicating dial was devised by mounting a circle cut from a sheet of polar co-ordinate graph paper on one of the dial wheels.

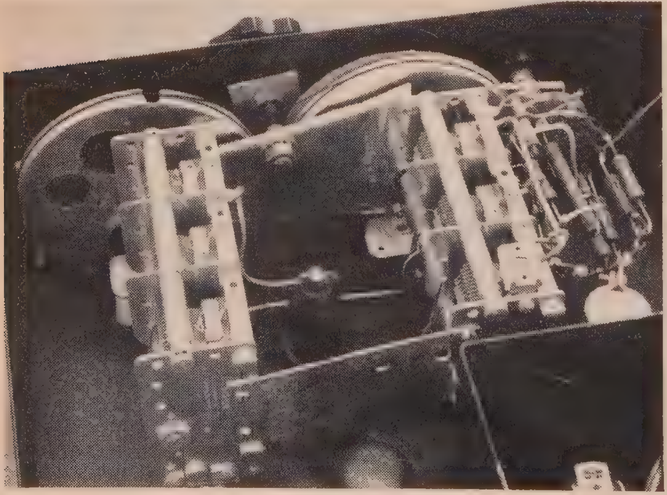
With two pentodes and the cathode follower a gain of about 380 exists before negative feedback is applied. Reducing this gain to three means that a maximum of 42 db of feedback has been applied. If values of coupling or filtering condensers are to be changed, it is recommended that a regulated power supply be installed. Otherwise you may have to contend with low frequency oscillations of a few cycles-per-minute.

The distortion data on the author's unit is presented in Fig. 3. The inevitable rise in low frequency distortion is apparent, a 3 db rise in distortion having occurred around 300 cps. The lamp-bulb distortion might seem to be creeping in at an unduly high frequency. However, even at 100 cps this effect contributes only 0.06% to a total distortion of 0.075%. Had the residual distortion in the amplifier been around one-tenth of one per-cent, the lamp distortion would just be starting to show up around 100 cycles. As it is, the residual distortion (to be attributed to the amplifier sections) is around 0.02%. This indicates the wisdom of having used the pentode and the cathode follower instead of just a pentode. The rise in distortion at higher frequencies indicates a loss of gain due to shunt capacitances. As the gain goes down the ability of the feedback loop to control distortion deteriorates. In addition, these shunt capacitances change the operating curves for the tubes so that they produce more distortion for a given output. However, a distortion figure of less than one-tenth of one per-cent at 50,000 cycles seems adequate, especially since most commercial harmonic distortion meters will read a little less than 0.10% distortion and will make such measurements only below 15,000 cycles.

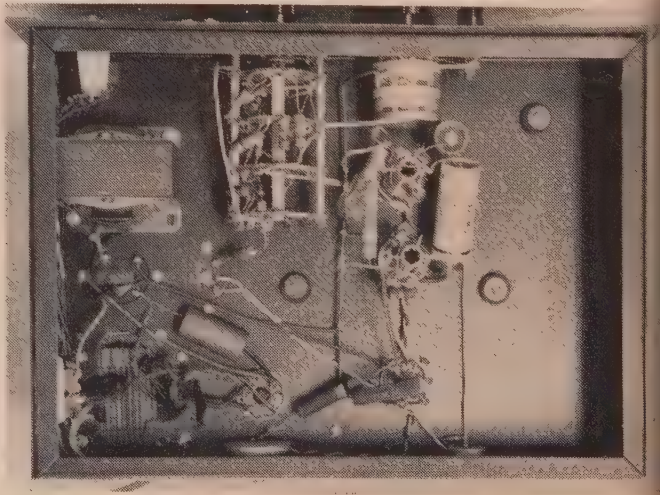
After several months of continual use, the equipment has proved to be very satisfactory. The relatively undistorted output is an obvious asset. That this distortion (including hum and noise) is still a very small fraction of the output even at very low output levels has proved of equal importance.

—30—

A close-up view, showing method of mounting and ganging the tuning condenser. See text for details on condenser changes.



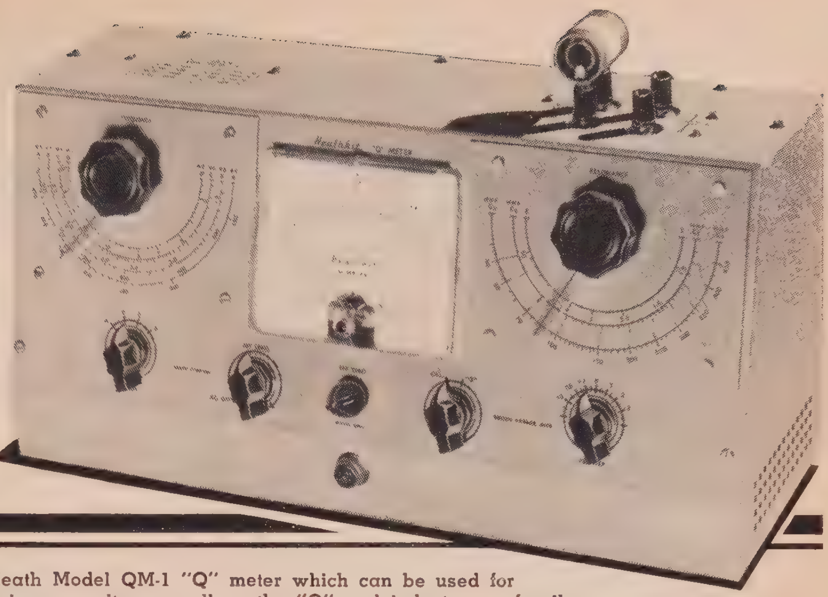
Under-chassis view, showing parts placement, condenser shock mounts, and attenuator assembly. All wiring is point-to-point.



VHAT'S THE Q·L·C

By

WARREN PHILBROOK


The Heath Model QM-1 "Q" meter which can be used for measuring capacity as well as the "Q" and inductance of coils.

The "Q" meter saves many hours on a radio and TV service bench testing those hard-to-check parts.

NE of the most useful instruments and yet one which is seldom seen in service shops or ham shacks is the *"Q"* meter, capable of deter- ning the inductance, the *"Q,"* and distributed capacity of a coil. The rument to be described, known as *Heath* QM-1, enables a technician simulate conditions actually en- ntered in practical circuits. In ad- on, the unit is capable of measur- the performance of a coil or con- ser by itself. The latter measure- nts are made at the operating fre- ncy actually encountered in the ctical circuit under observation.

hus, for example, during the de- n of a broadcast receiver, the loop enna which is to be used with the rument may be checked for its quency coverage and for loss of " due to the proximity of the chas- and other components to the an- na. Because there are many de- ns of loop antennas, their perform- es and behavior may be compared noting the indicated *"Q."* In addi- n, the distributed capacity of the antenna may be readily deter- ied.

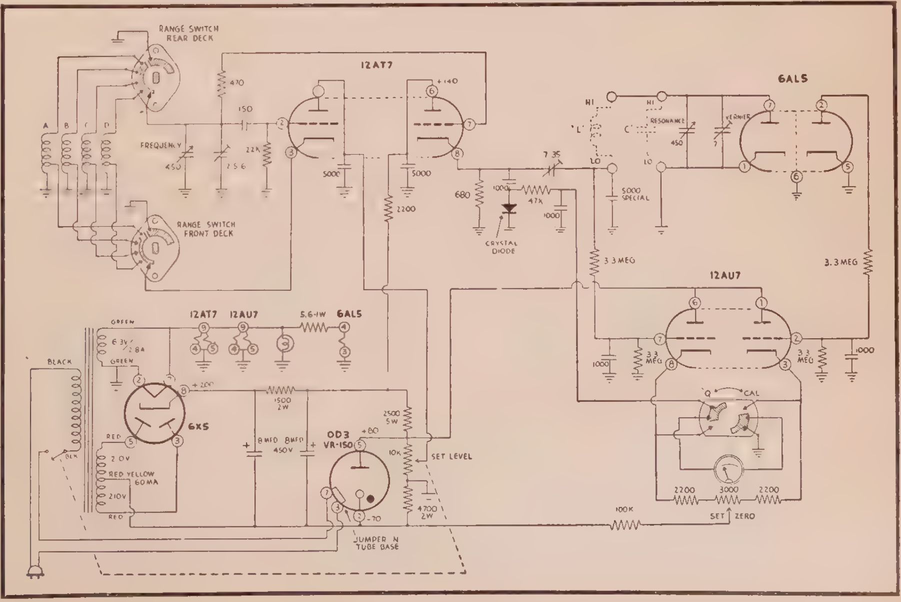
t is also convenient to have an in- ument which is capable of deter- ing the effective capacity of a ing condenser. Of equal impor- ce is the determination of the imum capacity, and this is made wn by direct substitution.

he *"Q"* meter has a wide field of lication in TV servicing. The most mon methods for testing peaking s, wavetraps, and chokes are to asure their resistance or to substi- e one that is known to be good for suspected part. Besides the delay n encountered in securing a sub- ute part, the original part may be d and the circuit fault may be where, but the technician won't w this until he makes the substi- on. A quick method for checking most critical value of the part is ch more efficient. Testing the re- ance of a coil is not always effec- since a few shorted turns will not change a coil's resistance appreciably, particularly if it has low resistance to begin with—but it will change its inductance and *"Q."* Peaking coils are a good example of this; their resistance is in the neighborhood of 10 ohms, and may vary a few ohms either way. A few shorted turns will not decrease such a low resistance appreciably. However, their inductance is on the order of 250 microhenrys and this may be noticeably reduced by even two shorted turns. Since most TV receiver schematics and service data will include the inductance of peaking coils (and usually not the resistance), this is an ideal way to test such components.

TV width coils, horizontal linearity coils, wavetraps, and choke coils may also be tested with the *"Q"* meter. The service technician will, undoubtedly, discover many more useful applications for the meter once he has become experienced in its use. For example, the service technician can make a series of *"Q"* and inductance measurements on good deflection yokes and horizontal output transformer coils in operating TV sets as they pass through his shop. If he lists the values obtained, the next time he works on a set with what he suspects is a faulty deflection yoke, he can take a *"Q"* measurement and compare it with the value he has listed for a good yoke in a similar circuit. This

(*Continued on page* 98)

Fig. 1. Schematic diagram of the Heath Model QM-1 "Q" meter described in text.



MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE

PERAMBULATING HOLES

"HEY, Mac," Barney addressed his boss, "How're you doing with your transistor experiments?"

"I'm learning about as fast as you could expect for an old dog," Mac said as he glanced up from the width coil he was installing. "The hard thing for me is to quit thinking about them as tube substitutes. I keep wanting to use transistors in straight tube circuits instead of working out new circuits designed for their peculiar characteristics. But why do you ask?"

"Well, I've been reading a few articles on them myself, but one thing has me stymied: I simply can't get this business of 'hole conduction' through my head."

"For a man already equipped with a hole in the head that ought to be easy," Mac murmured.

"Never mind the cracks, Wise Guy," Barney exclaimed. "In my book a hole is a large chunk of nothing, and how 'nothing' can conduct 'something'—even though that 'something' is only electrical current—throws me. When I think about it for a while I get that same too-many-rides-on-the-merry-go-round feeling I always have when I try to picture limitless space. Do you suppose you could straighten me out on this hole-conduction thing?"

"I can try," Mac said. "You know that an atom consists of a positive nucleus and a number of electrons circling around that nucleus. Normally the total negative charges of these electrons just balance the positive charge of the nucleus and so produce a net neutral charge on the atom. The electrons occupy various orbits or 'shells' at different distances from the nucleus. Those in the outermost shell are called valence electrons, and they can be thought of as sort of combining hooks that permit fastening the atoms together in a stable structure.

"For example, each pure germanium atom has four valence electrons, and each of these 'pairs' with a similar valence electron in an adjoining atom to constitute a lattice that fits together as neatly and completely as do the similar squares of a checker board.

"Suppose now we introduce into this geometrical paradise an impurity atom that has *five* valence electrons. When this five-sided stranger tries to fit in with our four-sided germanium atoms, it doesn't quite come off. Four of the valence electrons of the impurity atoms can tie in with valence electrons of four germanium atoms, but that leaves a single spare electron kicking around loose like a lone stag at a high school dance. The only way this unattached electron can pair with another valence electron is by first casting loose that electron's partner to go wandering around. It is kind of like the game of Pussy-wants-a corner. Since there is one more player than there are corners, one player always lacks a place to stay. When we add several five-valence-electrons atoms to pure germanium, we create a number of these unattached electrons in the mixture. The presence of these extra negatively-charged electrons gives the material a predominantly negative charge, and we call it *n*—for negative—type germanium."

"But what's all that got to do with holes," Barney interrupted impatiently.

"Keep your shirt on; I'm coming to that," Mac admonished. "Suppose we inject an impurity atom with only three valence electrons into our pure germanium. This three-sided atom will not fit into our four-sided ge manium atom structure any bett than did the other type of impurit Each of the three valence electro of the injected atoms can combine wi a valence electron from a neighbori atom to form a pair, but there will a fourth neighbor that will have electron with which to pair; in oth words that particular locality will one electron short.

"Remember that in our pure ge manium the positive and negati charges were balanced. Now, at th spot where the electron shortage e ists, there will be a positively-charge 'hole,' for a positive charge always r sults when we remove negativel charged electrons—in fact, you can d fine a positive charge as a deficienc of electrons."

"Okay, so you've created a hol now let's see you make it move," Ba ney challenged.

Mac arranged a row of ten ceram condensers on the bench about an inc apart. Then he removed the seco from the left.

"Let's pretend this gap from whi I took the condenser represents a ho in the germanium," he said. "Lo what happens when I slide #3 co denser over into the place of the mis ing #2: the gap has moved one spa to the right. If #4 condenser is sl to the left our gap moves again to th right. We can keep right on slidi condensers to the left into the ga and the gap will continue to move the right until it reaches the end the line. Be sure and note that th gap moved only when a condens moved; yet each condenser move only about an inch while the ga moved from one end of the line to th other.

"That's exactly how the positivel charged hole moves through the ge manium. A valence electron fro an adjoining atom is attracted in the hole and fills it, but in doing th it leaves a hole at the place fro where it came. For all practical pu poses, the hole jumps from whe this moving electron is to where was. Another electron plugs this ne hole and creates another hole at former resting place. In this fashio skipping from atom to atom, our ho moves through the germanium. Exce for the fact that its charge is positi instead of negative, we can treat exactly as we do an electron. It w seek a negative electrode just as electron seeks a positive electro Material containing a large number three-valence-electrons atoms is pr dominantly positive and is called *p* for positive—type germanium."

"You know," Barney grudgin admitted, "I think I'm beginning understand how this hole busine works. Now why don't you go on a brief me on the whole subject of ho transistors tick?"

"Oh no you don't!" Mac said firm "As Confucius really said, 'When have presented one corner of a su ject, and the pupil cannot of hims e out the other three, I do not re- the lesson.' You said the thing puzzled you was the idea of holes how they moved about. Now that leared up, you can go back and ad those magazine articles on sistor theory and possibly get e sense out of them. Anyway, I'm o your little game. You are try- to keep me talking so I won't ce how long you have been on that e set. What's the matter with

That's what I'm trying to find out," ney said tartly. "The little cuss got what you might call confus- symptoms. It has no pep on weak ions; yet it overloads on strong ions. When I noticed the overload- I checked the a.v.c. voltage and nd a very funny thing: On weak ions or even on no station at all, voltage on the a.v.c. bus is two or e volts high; yet when I tune in local station, this voltage only up a few more volts. The resis- in the a.v.c. system are all nor- in value; I unsoldered the con- sers and checked them for leakage nout finding any; and I've tried stituting all new tubes. You got bright ideas?"

As the French say, 'When in doubt, *chez* la diagram'," Mac remarked ne slid a service manual from the f and flipped it open. He studied diagram of the little set intently a few minutes, compared the pic- ed view of the bottom of the re- er with the set itself, and then t the book.

Put the vacuum tube voltmeter on a.v.c. bus again," he told Bar-

The boy clipped the meter to "B- us" and the a.v.c. lead and ob- ed a reading of around six volts n when no station was tuned in. en the local station was being re- ed, this value rose to only eight nine volts and the reception be- e distorted. While watching the er, Mac reached over and placed finger on the stator of the oscilla- tuning condenser. Immediately the er needle fell back to a reading of ut one volt. When the finger was oved, the pointer jumped back up he original high value.

What does that tell you?" Mac ed Barney.

Only that when you kill the oscil- r the a.v.c. voltage returns to nor- . Do you suppose that the oscilla- is somehow feeding through to the le detector and is being rectified is causing that high a.v.c. volt- ?"

Hardly seems likely," Mac de- rred. "And that still would not lain the fact that you cannot de- op enough voltage on a strong sta- . Take the noise-locating probe the signal tracer and check this e mica condenser right here."

arney switched the signal tracer he "Noise" position, which placed oltage of about two hundred volts

(*Continued on page* 117)

TV PARTS REPLACEMENT GUIDE

TV POWER TRANSFORMERS

Concluding the list of power transformers used in TV sets and their replacements available from most distributors.

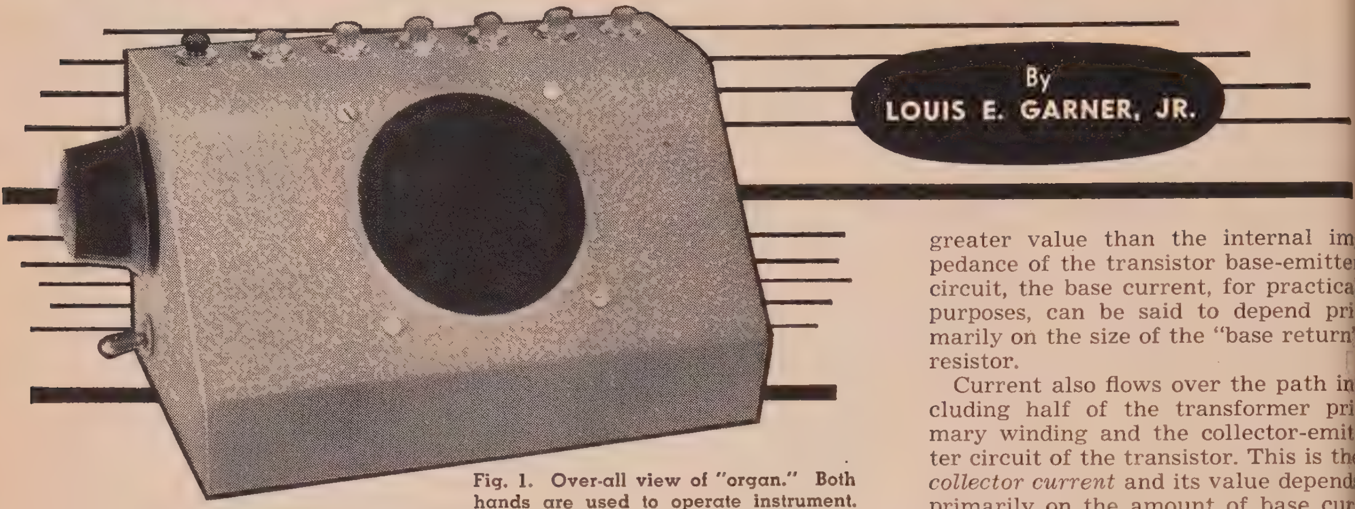
All data was furnished by the parts manufacturers listed.

RECEIVER MFR. Part No.	CHICAGO Part No.	HALLDORSON Part No.	MERIT Part No.	TRIAD Part No.	THORDARSON Part No.
PHILCO					
32-8303	TP-405†	P9711†	P-3053	R-37BC	T-26R00
32-8364-1	TP-350				
32-8376	TP-450	P9725	P-3054	R-40BC	T-26R19
32-8381			P-3079		
32-8391	TP-450†	P9725	P-3054	R-40BC	
32-8411-1	TP-355†	P9711	P-3169	R-35A	T-26R19
32-8417	TP-450†	P9727		R-40BC	
32-8423-2		P9713	P-3059	R-37BC	T-26R00
32-8429			P-3055	R-50BC	
32-8452			P-3076		T-26R21
32-8468		F5905		F-51X & 52X	
32-8469	TP-319	P9737	P-3055	R-50BC	
32-8481		P9737	P-3053	R-50BC	
32-8488		P9737	P-3053		
RCA					
7874			P-3063		
37048	PH-145	P9317		R-18B	T-26R23
71415	TP-365	P9731	P-3061	R-31BC	T-26R00
71772	TP-392	P9713	P-3059	R-35BC	T-26R19
71975	PH-70B†*	P9713	P2951†	R-11B	TS-24R04
72177	PH-200	P9705	P-3063	R-20B	T-26R23
73567	TP-383	P9709	P-3063	R-33BC	T-26R19
73601	PH-70	P9215	P-2952*	R-5B & F-16X	
74046	TP-392	P9711	P-3063	R-35BC	T-26R19
74143	TP-383	P9719	P-3053	R-37BC	T-26R00
74586	TP-370	P9711	P-3063	R-38BC	T-26R00
74874	TP-356	P9731	P-3063	R-38BC	T-26R00
74949	TP-360	P9731	P-3063	R-35BC	T-26R19
74981	TP-356	P9711	P-3078	F-51X & R-35BC	T-26R00
75084	TP-356	P9731	P-3053	F-16X & R-37BC	T-26R00
75207	TP-280		P-3079		
75508	TP-360, 368	P9705	P-3059	R-38BC, 33BC	T-26R19
75566		P9305	P-3051		
76429	TP-280		P-3079		
76495	TP-356	P9737		R-37BC & F-51X	T-26R00
91975		P9311			
940762-1		P9713	P-3063		
RAYTHEON					
B-12D-19250				F-50X	
C-12A-17822	TP-355	P9711	P-3059	R-20BC	T-26R23
C-12A-18399	TP-360	P9711	P-3059	R-35BC	T-26R19
C-12A-18839	TP-360	P9711	P-3059	R-35BC	T-26R19
C-12A-19942	TP-356X	P9711	P-3059	R-37BC	T-26R00
12A-18839		P9711	P-3059		T-26R21
SENTINEL					
22E30	TP-410*	P9707		R-20B	T-26R23
22E43	TP-405 & FO-615		P-3078	R-38B	T-26R00
22E53				R-36B & F-52X	
22E56				R-33B & F-52X	T-26R00
SILVERTONE					
52C-185		P9702	P-3169	R-42A	TV-24R98
A-1098		P9717		R-35B	T-26R19
A-10109	TP-360	P9705†	P-3069	R-47BS	T-26R19
M-52C199	TP-370[1]	P9708	P-3169	R-38A	T-26R00
N-22397	TP-225		P-3070	R-39B	T-26R21
N-23837	TP-315	P9715		R-39A	T-26R21
N-23840	FO-610†	F5516	P-2948	F-21A	T-21F12
R-65432	PH-70*	P9213	P-3048	R-37B	
R-65463	TP-395	P9719†	P-3059	R-37B	
R-66191	PH-70*	P9213		R-5B	
R-67304		P9213	P-3059	R-5B	
R-70190	TP-395	P9719	P-3053	R-36B	
TR-21			P-3148	R-8A	
TTR-105	TP-355	P9713	P-3063	R-35B	T-26R19
TTR-170D		P9731		R-38B	T-26R00
TTR-182D	TP-405 & FO-615	P9731	P-3078	R-38B	T-26R00
TTR-188D	TP-360†	P9711	P-3059	R-35B	T-26R19
W-508060	TP-375	P9717	P-3067	R-35B	T-26R19
W-508702		P9717	P-3067*	R-40B	
W-509380	TP-370*	P9705	P-3055		

* Add series resistor. † Drill new mounting holes. [1] Use universal mounting brackets. [2] Use resistor in rectifier plate lead.

(Continued on page 70)

A TRANSISTOR "ELECTRIC ORGAN"



By
LOUIS E. GARNER, JR.

Fig. 1. Over-all view of "organ." Both hands are used to operate instrument.

An interesting project for the experimenter, this battery operated unit requires few parts for its construction.

ALTHOUGH the device shown in Fig. 1 is not an "organ" in the truest sense of the word, it is capable of producing tunes when operated by a person of moderate skill. In fact, the operator need not be a skilled musician. The average person, with a little practice, can "pick out" tunes, playing one note at a time.

As a toy, the "electric organ" shown is of real value. The author has several times turned his model over to his children, who enjoy playing with it in preference to their more conventional toy pianos, toy xylophones, toy guitars, and other toy musical "instruments." But the value of the device as a toy is not limited to its appeal to children. Although the output is obtained through a loudspeaker, the volume is not so high as to prove distracting to the parents. The children can "make music" to their little hearts' content while the parents, in an adjoining room, can watch television, listen to the radio, or even read, without distraction.

Another real advantage of the "electric organ" shown is its independance from the power line, and the fact that there is relatively no danger of electric shock. Nor is the design such that the battery used has to be replaced every day or so. With average use, the battery should last its normal "shelf life."

These desirable characteristics, for a toy, have all been made possible by utilizing a *Raytheon* junction transistor in a simple oscillator circuit. As can be seen by reference to the schematic diagram, Fig. 2, relatively few other parts are required for the operation of the unit.

Referring to the schematic diagram, Fig. 2, a type CK722 transistor is connected as a modified grounded-emitter "Hartley" oscillator. The emitter is connected through push-button switch S_8 to the positive terminal of a small hearing-aid type battery, and the collector is connected through one-half of the transformer (T_1) primary winding to the negative terminal of the battery.

The necessary feedback signal for operation is obtained from the other half of the transformer primary winding, which is connected through coupling condenser C_1 to the base of the transistor.

Resistors R_3 to R_8 serve as "base return" resistors, with the desired resistance selected by depressing the proper push-button (S_2 to S_7). If toggle switch S_1 is thrown, the "base return" resistor becomes R_1 and R_2 in series. Since R_1 is variable, the total resistance value can be adjusted from the value of R_2 to the sum of R_2 and R_1 or from 8200 ohms to more than 2 megohms.

The 3" PM loudspeaker is connected to the proper taps on the secondary winding of T_1. Transformer T_1 thus serves both as an "oscillator coil" and as an "output transformer."

In operation, one of the resistor switches, S_1 to S_7, and the power switch, S_8, are thrown simultaneously. Battery current can then flow over two paths.

Part of the current flows through the "base return" resistor and the base-emitter of the transistor, establishing the bias current for the transistor. The amount of bias current obtained depends on the battery voltage and the total impedance of the resistor plus the internal base-emitter impedance of the transistor. Since the external resistor generally has a greater value than the internal impedance of the transistor base-emitter circuit, the base current, for practical purposes, can be said to depend primarily on the size of the "base return" resistor.

Current also flows over the path including half of the transformer primary winding and the collector-emitter circuit of the transistor. This is the *collector current* and its value depends primarily on the amount of base current flow (as well as on the battery voltage).

Any changes in collector current induce an a.c. voltage in the primary of transformer T_1. This voltage is coupled through condenser C_1 to the base of the transistor, adding an a.c. component to the d.c. base current, and causing corresponding changes in collector current. Thus, the basic conditions for oscillation are set up—positive feedback from output to input circuit, coupled with stage gain.

The frequency of operation depends on the transistor characteristics, on the transformer used, on the value of coupling condenser C_1, and on the size of the "base return" resistor. Varying any of these factors permits the frequency to be changed. In practice, it has been found easiest to vary the size of the "base return" resistor, hence a selection of resistors (R_3 to R_8) with corresponding switches (S_2 to S_7).

Where a continuously variable resistor is used (R_1), the frequency can be easily varied over wide ranges. In the model shown, the output frequency can be varied continuously from about 20 cps to about 10 kc. simply by adjusting R_1.

The frequency of operation bears an inverse relationship to the size of the "base return" resistor, that is, as the resistor value is reduced, the frequency of operation increases.

At the same time, the base current (and hence the collector current) increases. Thus, at high frequencies the battery current drain is several times greater than at lower frequencies. It is this characteristic that makes it necessary to provide a fixed resistor (R_2) in series with the continuously variable control. Thus, R_2, although limiting the maximum frequency of operation when the variable control is used, also limits the maximum base and collector current and thus serves to protect the transistor from damage.

Since oscillation is obtained by means of "brute force" feedback rather than by employing a tuned ci the signal obtained is not a sine e. Rather, it is extremely rich in ionics. The exact waveform obed varies with frequency, and also the characteristics of the tranr and transformer used.

Construction Hints

cause of the simplicity of the cir- duplication of the model should prove at all difficult for the aver-echnician. The only real care that be exercised is when installing ransistor. If the transistor is sold directly into the circuit (instead socket being used), especial care be taken that the transistor s are not overheated.

rcuit layout, lead length, and lead ngement all are completely non-cal. It is suggested, however, standard good wiring practice be wed.

ie author's model has been assem- in a standard *ICA* sloping front het, and easily obtained push-but- switches used for the various s." A different color push-button ck) was used for the "power" (S_8) than for the "tone" keys o S_7—red push-buttons were used). Six notes were provided, plus a inuously variable control (R_1).

ie prospective builder may use arrangement of keys and case h he feels is desirable. An ingeni-technician should have no diffi- in modifying the keys of a toy o to serve as switches for the tric organ," assembling the rest ie components within the case of piano. If space permits, the loud-ker could be mounted within the piano case, otherwise it could be nted separately (a sloping panel r case makes an excellent "baffle" a 2″ or 3″ speaker).

preferred, a 5″, 6″, 8″ or larger ker may be used in place of the peaker used by the author.

ie transformer used by the author the "universal replacement" type a multi-tapped secondary wind- If the builder uses a similar sformer, he should experiment loudspeaker connections to the rent taps, choosing the pair giv-he best results.

though only six "keys" (and e six notes) are provided in the el shown, any number of keys may used, simply by adding more ches and different value resistors. , if a child's toy piano is used as basic unit, a different note can be lied by every key on the board.

nce the frequency (tone) of the obtained as each key is depressed nds not only on the size of the e return" resistor (R_3 to R_8) but on the individual characteristics he transistor and transformer there is no simple way of deter-ng the size of these resistors in nce. Rather, they are determined rimentally after the unit is wired tested.

vo methods may be employed for sing these resistors. If the completed unit is to be used primarily as a toy, the resistor values may be chosen arbitrarily without regard to the notes obtained. This method was used in the author's model. A series of resistors having values of 150,000, 170,000, 190,000, 210,000, and 260,000 ohms were used.

On the other hand, if the builder intends to use the completed unit to play actual tunes, each key should be adjusted to give the desired musical note. This can be done either by using a potentiometer to determine the proper resistor value, later permanently installing a fixed resistor, or by using a rheostat for each resistor. The second method is the more flexible as it permits readjustment at any time, but is also the more expensive, requiring a separate potentiometer for each note to be sounded.

(*Note:* For the frequency of various musical notes, refer to "Fun with a Home-Built Electronic Organ," by Jim Kirk, Radio & Television News, March 1953.)

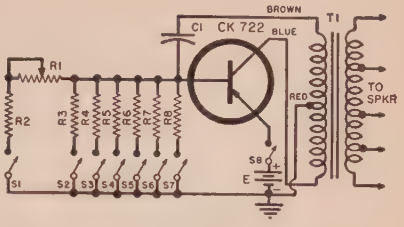
The continuously variable control was included in the author's model more as a novelty than for any serious purpose. However, it does permit unusual tonal effects to be obtained, and may be either retained or omitted, as desired by the builder. Some builders may even wish to provide several such controls.

Operation

In the author's model a separate power switch, as such, has not been provided. Rather, the power switch (S_8) becomes one of the "playing keys."

To sound a particular note, the desired "tone key" (S_2 to S_7) and the "power key" (S_8) are depressed simultaneously. They are held down long enough to sound the desired interval (quarter note, half note, full note, etc.) and then released together.

Either one finger of each hand may be used, in approved "hunt and peck" typewriter style, or the fingers of both hands may be employed to cover all the operating "keys." The latter technique requires considerably more practice to be used successfully than the former.



R_1—2 megohm carbon pot
R_2—8200 ohm, ½ w. res.
R_3, R_4, R_5, R_6, R_7, R_8—½ w. carbon res. (see text for values)
C_1—.01 µfd. disc ceramic cond.
T_1—Output trans., single or push-pull plates, 4000-10,000 ohms to v.c. (Stancor A-3856 or equiv.)
S_1—S.p.s.t. toggle sw.
S_2, S_3, S_4, S_5, S_6, S_7, S_8—S.p.s.t. push-button sw.
E—15 volt hearing-aid battery (Burgess U-10)
Spkr.—3″ PM loudspeaker
CK722—Junction-type transistor (Raytheon)

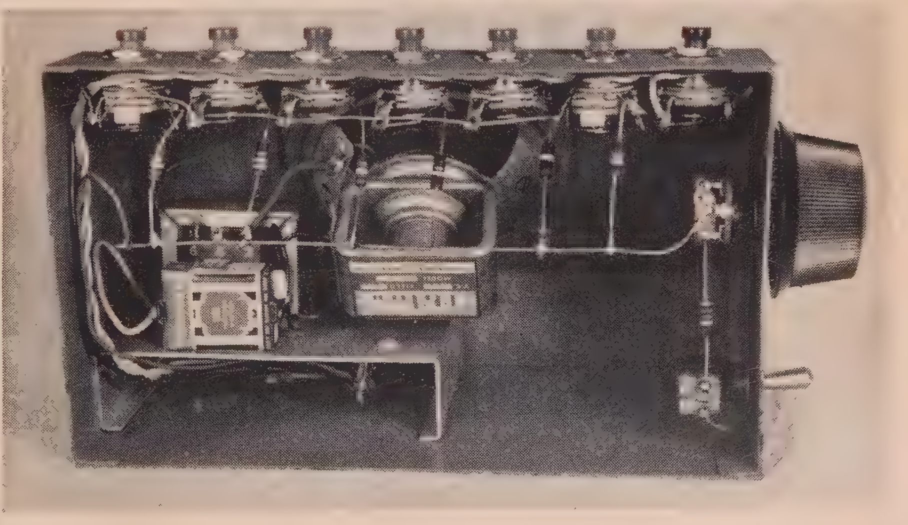
Fig. 2. Schematic of transistor "organ."

To use the continuously variable control, the toggle switch (S_1) is thrown. One note at a time may be sounded by rotating the knob (on the side of the case in the author's model) to the desired position, then depressing and releasing the "power key." If a continually changing note is desired, the "power key" is held down while the control knob is rotated back and forth. Quite eerie effects can be obtained by doing this.

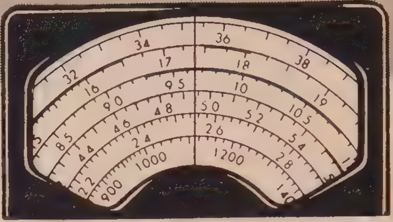
Since depressing more than one "tone key" at a time essentially connects two or more resistors in parallel, considerable change in resistance, and hence in the frequency of the note sounded, results. This enables the operator to achieve unusual tonal effects by depressing two, three, or more of the "tone keys" simultaneously. Other effects may be obtained by using the continuously variable control in conjunction with the individual "tone keys" (by throwing toggle switch S_1 and then depressing a "tone key" and the "power key" simultaneously).

—30—

Fig. 3. Internal view of unit. The "organ" is housed in a standard instrument cabinet.



International SHORT-WAVE



Compiled by **KENNETH R. BOORD**

THE INTERNATIONAL SHORT-WAVE CLUB, London, is now carrying on its second short-wave station popularity contest. Until July 31, all short-wave listeners throughout the world—*whether members of ISWC or not*—are invited to write down names of their three favorite short-wave broadcasters; in as few words as possible, explain why the No. 1 choice is the favored station; then mail this vote to Arthur E. Bear, Secy., ISWC, 100, Adams Garden Estate, London, S.E. 16, England. Suitable prizes will be awarded for best explanations, and results will be announced in the August bulletin of ISWC.

* * *

Club Notes

England—Headquarters for the International Short-Wave League is 86, Barrenger Road, London N. 10, England; editor is J. Eric Alban, G3JEA, 85, Inverness Terrace, London, W. 2, England. (*Monitor*) W. A. Winchester, 4, Woodgate Road, Eastbourne, Sussex, England, head of the ISWL Correspondence Bureau, would be glad to hear from anyone interested in corresponding with persons in other countries (list choice of countries); an IRC should be enclosed, along with a self-addressed envelope for reply.

Japan—The Japan DX Radio Club, Box 7, Nerima, Tokyo, Japan, publishes an Overseas Edition of its bulletin (in *English*); welcomes members from throughout the world. (Ishikawa, Japan)

USA—The annual outing of the United 49'ers Radio Society will be July 18 at the farm of Jim Pickering, Highstown, New Jersey.

* * *

Around the World

Albania—Radio Tirana, 7.850, 6.560, now has news 2345-2400, 1415-1430. (Pearce, England)

Anglo-Egyptian Sudan—Radio Om*durman,* listed 524 kc., 6.437, 7.600, gives schedule as Arabic daily 2315-2345, 1130-1430; Fri. only 0300-0430, 0900-1000; Sun. only 0300-0400; in *English* on Fri. 1230-1300, Sun. and Wed. 1115-1130. (Hardwick, N. Z.)

Angola—Radio Clube de Huilla, 10.048, noted 1335 with talk in Portuguese; often has severe CWQRM (Pearce, England) Closing 1600 wit "A Portuguesa;" *measured* 10.04 (Earnhardt, N. C.) Luanda, 11.862A was noted recently on *extended* schedule to 1830 closedown. (Niblack, Ind. Mercier, France, says CR6RO, Silv Porto, is still using 7.582 to 1530 closedown; best around 1415. (*Nattugglan* Sweden)

Argentina—LRA, 9.69, signs on no 2030 instead of 2100; Spanish. (Balb Calif.) Noted at good level in *Englis* 1800 over 15.345. (Jacobson, Ill., others)

Australia—By this time, *Radio Australia* should have moved from 11.84 to 11.810 for the North American Eas Coast "morning" beam 0700-0845, wit Sunday DX session 0830.

Azores—Ponta Delgada's 11.090 outlet is on *summer* schedule of 140 1500. (Ferguson, N. C.) Heard o 4.865 at 1530 with news in Portugues

Bechuanaland — Mafeking's 5.90 outlet is strong in South Africa 140 1500. (Sarkady)

Belgian Congo—OTM2, 9.380, Leopoldville, noted closing 1600 at excellent level in N. J. (Scheiner) OTM 6.295, noted with *English* announcement 2327, good level, some QRM (Dadson, Mich.)

Belgium—ORU, 6.000, signs on 130 with multilingual calls including *English;* this service runs 1300-1600 f Northern Europe. (Pearce, England Heard over 11.850 at good level 140 (Scheiner, N. J.) Noted on 17.8 with news 0515. (Sanderson, Australia.) ORU heard over 9.767 to Nort America 2000-2205 (some days 2230) parallel OTC, 9.655, Leopoldville, Belgian Congo. (Matherly, Ohi others)

Canada—CJCX, 6.010, Sydney, N.S has news 1830, frequent commercial (Niblack, Ind.) CHNX, 6.130, Halifa N.S., noted 2230-2313 sign-off. (Hamilton, Mo.)

Cape Verde Islands—CR4AA, ne 7.400, noted signing on with "A Portuguesa" 1500; news in Portugue 1545; off 1658 with "A Portuguesa (Pearce, England)

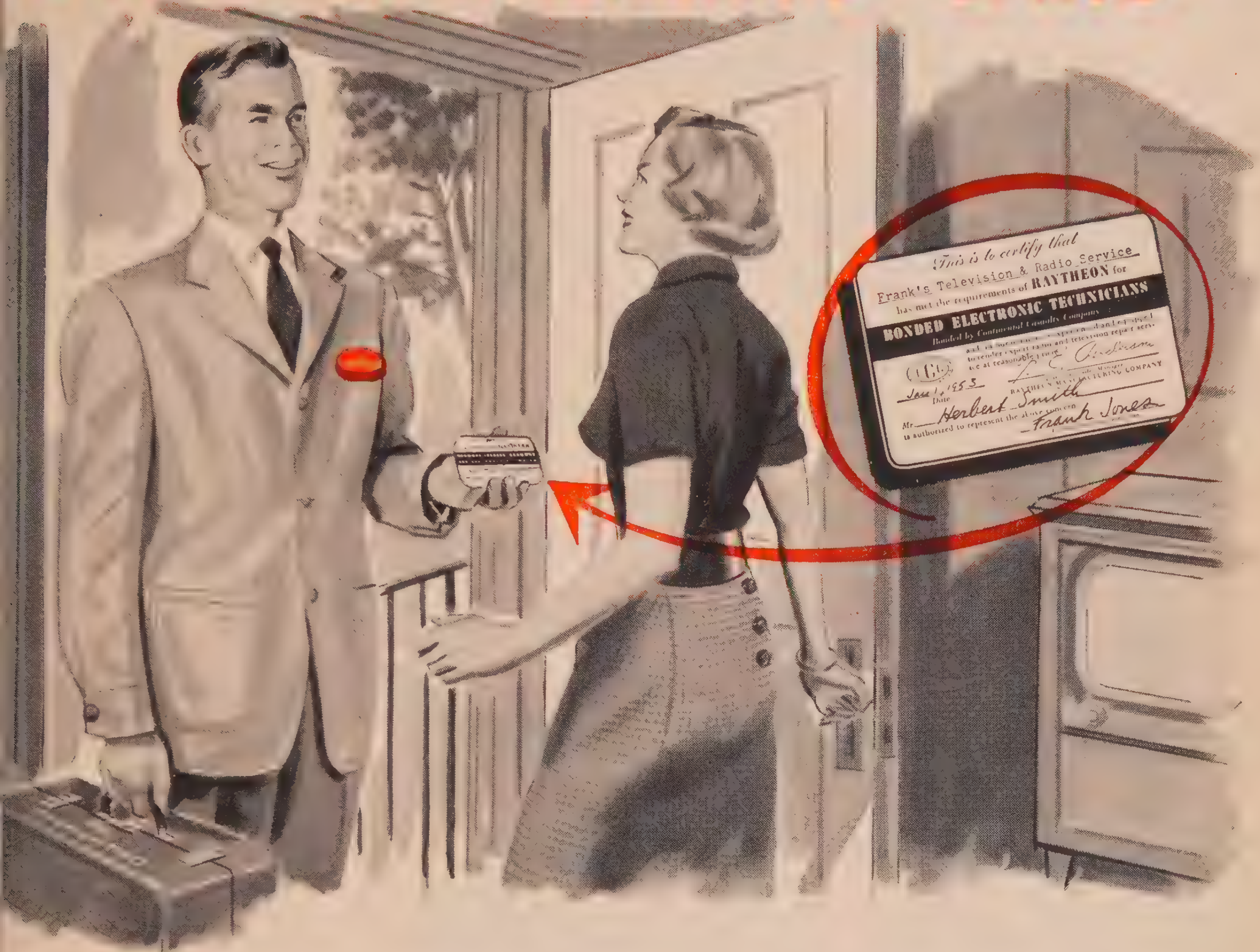
Ceylon—Colombo, 9.57, relays VO currently 0830-1200 to India-Pakistan; heard well in Britain. (O'Sullivan) *Radio Ceylon,* 3.320, noted 06 with musical program, commercia (Sanderson, Australia) Good level 11.975 at 1030 relaying VOA. (Jacobson, Ill.; Fuller, R. I., others)

(*Continued on page* 104)

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

This attractive Listening Post of veteran DX-er J. W. (Jack) Sherman, Tampa, Florida, is built around a National HRO. Sherman has an ingenious system of antenna masts and towers, all built so they can be lowered to the ground and anchored safely in about five minutes to avoid hurricane damage to his rather elaborate installation.

IERE'S A WINNING CARD...


This is to certify that
Frank's Television & Radio Service
has met the requirements of RAYTHEON for
BONDED ELECTRONIC TECHNICIANS
Bonded by Continental Casualty Company
to render expert radio and television repair service at reasonable prices
RAYTHEON MANUFACTURING COMPANY
June 1, 1953
Date
Mr. Herbert Smith
is authorized to represent the above concern
Frank Jones

'he RAYTHEON Bonded Electronic Technician's Identification Card

s mighty important to customers. It instantly dentifies the bearer as an expert technician epresenting a reputable company — lends re-ssurance to the apprehensive set owner.

But this is only one of the ways the *Raytheon Bonded Electronic Technician Program* helps you. The cash-protection of the Raytheon Bond (backed by Continental Casualty Company), the Raytheon "Code of Ethics" and the sound, sensible business methods the code suggests all help to create customer confidence and good will. That means more business now, and more business in the future from a steadily increasing backlog of satisfied customers.

This potent weapon in the war against consumer mistrust is yours *without cost* if you can qualify for it. It is Raytheon's investment in *your* future. Call your Raytheon Tube Distributor today, and ask him if you can become a *Raytheon Bonded Electronic Technician.*

RIGHT...FOR SOUND AND SIGHT

RAYTHEON®

RAYTHEON MANUFACTURING COMPANY
Receiving Tube Division
Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Calif.

Excellence in Electronics

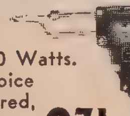
RAYTHEON MAKES ALL THESE:
CEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES

BARGAINS • BARGAINS • BARGAINS

Famous STEVE-EL BRANDED **TUBES** *All Brand New* *Individually Boxed* FAR BELOW WHOLESALE COST!

1A7	$0.59	6AS5	.49	6J6	.79	6X4	.34	12SL7	.57
1B3	.63	6AQ5	.39	6K6	.41	6X5	.37	12SN7	.54
1P5	.54	6AT6	.37	6L6G	.89	7C6	.42	12SQ7	.42
1R5	.56	6AX4	.52	6S4	.44	7N7	.52	14AF7	.59
1S5	.48	6B8	.52	6SA7	.52	7X7	.62	14N7	.64
1U4	.48	6BA6	.45	6SG7	.49	12A6	.48	19T8	.78
1U5	.48	6BC5	.58	6SK7	.49	12AT6	.48	25BQ6	.77
1X2	.63	6BC7	.86	6SL7	.52	12AT7	.68	25W4	.48
3V4	.48	6BE6	.48	6SN7	.54	12AU6	.48	25L6	.48
5U4	.47	6BG6	1.21	6SQ7	.42	12AU7	.56	25Z6	.42
5W4	.46	6BH6	.62	6SR7	.44	12AV6	.52	35C5	.47
6A7	.62	6BJ6	.53	6T8	.74	12AX7	.69	35L6	.48
6A8	.51	6BN6	.74	6U6	.57	12AZ7	.94	35W4	.37
6AG5	.62	6C4	.34	6U8	.78	12BA6	.46	35Z5	.33
6AK5	1.14	6CB6	.48	6V6GT	.46	12BA7	.59	50B5	.48
6AL5	.41	6CD6	1.21	6V8	.83	12BE6	.46	50C5	.47
6AU6	.43	6F6	.49	6W4	.45	12SA7	.52	50L6	.48
6AV6	.37	6J5	.37	6W6	.52	12SK7	.49	80	.38
								117Z3	.36

WEN ELECTRONIC SOLDERING GUN



250 Watts.
Choice of red, green, black. 9.71 each
Lots of 3 $8.64

AUTO SPEAKER

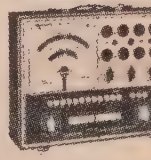
Special Sale!
Famous Brand All New!
5" 4 ohm
5½" 4 ohm
6" 4 ohm
$1.09 ea.
Any assortment of 10.......99c ea.
Minimum Order $5.00

3 SPEED Portable RECORD PLAYER

Complete with amplifier, speaker, permanent needle. Smart leatherette case.

Lots of 3...... $14.99
$15.99 each

SUPREME TESTERS



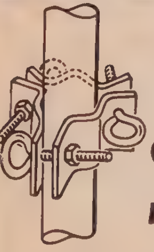
Model 600—Tube & Set Tester $89.95
Model 616—Tube & Battery Tester $69.95

Another NEW STEVE-EL STORE!
166 Washington Street, New York City
Come in and get acquainted

STEVE-EL ELECTRONICS CORP.
Dept. N-7 61 Reade St. COrtlandt 7-0086 New York 7, N. Y.

BARGAINS • BARGAINS • BARGAINS

South River ★★ NEWS ★★



GUY WIRE CLAMP

Model GC-3

Clamps on mast with a sure grip . . . accommodates mast to 2" O.D. Features 3 eyebolts for guy wire attachment.

Model GC-1 . . . 12 holes for guy wire attachment. Accommodates masts to 1½" O.D.

Model GC-2 . . . similar to Model GC-1 with 2 eyebolts for guy wire attachment.

South River Antenna Mounting Accessories are carried by every leading TV Parts Jobber from coast to coast.

Write for your copy of our new 1953 catalog.

SOUTH RIVER METAL PRODUCTS CO., INC.
SOUTH RIVER, N. J.
PIONEER AND OUTSTANDING PRODUCER OF FINEST LINE OF ANTENNA MOUNTS

Silencer

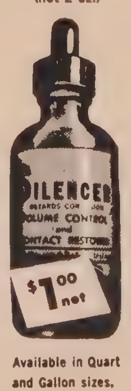
An Amazing Permanent Protective Film

which will

- ● Instantly clean and remove rust from controls, bandswitches, tuner assemblies, etc.
- ● Lubricate and Silence all moving parts
- ● Leave a protective coating which will last indefinitely

Silencer is not an oil that gums controls or changes capacity. As a cleaner it is 100 times more effective than carbon tetrachloride.

3 Full Oz.
(not 2 oz.)



Available in Quart and Gallon sizes.

Tell your Distributor you want Silencer

Illinois
RESEARCH LABORATORIES
22 W. Madison St.
Chicago 2, Illinois

TV Circuit Tracing

(*Continued from page* 56)

low-voltage power supply. This could be the trouble here, too, but the same symptoms will also be produced by a defective 25L6GT.

Another consequence of this arrangement is that any lowering of the +135 volts by some defect in the audio system will tend to produce a weak video output coupled possibly with a dim raster or no raster at all. Thus, increase in grid bias would raise the internal resistance of the audio amplifier and reduce the 13 volts to a lower value. The television technician who is unable to properly follow the d.c. distribution circuits in this (and similar) systems would certainly waste a lot of valuable servicing time wondering where to start.

With the foregoing explanation in mind, would you like to test your circuit tracing ability? If so, then study the schematic diagram of the *RCA* television receiver shown on page 50. See how much difficulty you have answering the following questions, all of which pertain to this circuit.

1. List the d.c. voltage or voltages which are supplied by the power supply directly at its output.
2. Are there any other "B+" lines in the set? If so, what are their voltages and how were these obtained?
3. From which "B+" line do the following stages (or portions of stages) receive their voltages?
   - *A*. 2nd video i.f. amplifier.
   - *B*. Audio output stage.
   - *C*. Sync output stage (V_{112A}).
   - *D*. Anode No. 1 (at pin 10) picture tube.
   - *E*. R.F. amplifier.
   - *F*. Ratio detector (V_{103}).
4. What stages are tied into the boost "B+" line?
5. Does the power supply furnish negative voltages to the receiver circuits?

Answers to these questions will be found on page 114 of this issue. Check your answers against these to see how well you can trace the d.c. distribution paths in this television receiver.

—30—

HAMFEST SCHEDULED

THE South Hills Brass Pounders and Modulators have scheduled their fifteenth annual hamfest for Sunday afternoon, August 2nd.

The event will be held at Spreading Oak Grove and Totem Pole Lodge, South Park, Pittsburgh, Pa. from noon until dark.

Registration is $2.00. A hot lunch will be available on the grounds at a nominal cost.

Entertainment has been planned for the ladies as well as an extensive series of events for hams. Prizes will be offered in various classifications.

Additional information is available from John Duggan, W3OBO, c/o the club at 709 Forbes St., Pittsburgh 1 Pa.

—30—

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL**	CHANNEL	FREQUENCY (mc.)	POWER* (Video)
California	Fresno	....	47	668-674	210
"	San Francisco	....	32	578-584	81
Indiana	Waterloo	....	15	476-482	20.5
Iowa	Cedar Rapids	WMT-TV	2	54-60	54
Kentucky	Richmond	....	60	746-752	81
Michigan	Cadillac	....	13	210-216	290
Minnesota	Minneapolis	WTCN (sharing air time with)	11	198-204	316
"	St. Paul	WMIN-TV	11	198-204	316
Missouri	Cape Girardeau	....	18	494-500	11
Montana	Great Falls	KMON-TV	3	60-66	1.7
New Hampshire	Keene	....	45	656-662	23
New York	Albany	WROW-TV	41	632-638	200
Oklahoma	Miami	....	58	734-740	1.75
Rhode Island	Providence	....	16	482-488	210
South Carolina	Greenwood	WCRS-TV	21	512-518	93
Texas	Abilene	KBRC-TV	9	186-192	17.4
West Virginia	Wheeling	....	7	174-180	316

REVISED CALL LETTER LISTING

(Since the publication of the listings in April, May, and June, the following final TV call letters have been assigned to new stations by the Commission.)

STATE	CITY	CALL	CHANNEL	FREQUENCY
Arizona	Yuma	KIVA	11	198-204
California	Monterey	KMBY-TV	8	180-186
"	Salinas	KSBW-TV	8	180-186
Colorado	Grand Junction	KFXJ-TV	5	76-82
Florida	Panama City	WJDM	7	174-180
Idaho	Idaho Falls	KID-TV	3	60-66
"	Pocatello	KISJ	6	82-88
Illinois	Bloomington	WBLN	15	476-482
"	Champaign	WCIA	3	60-66
"	Harrisburg	WISL-TV	22	518-524
"	Springfield	WICS	20	506-512
Indiana	Indianapolis	WNES	67	788-794
"	Indianapolis	WJRE	26	542-548
Kansas	Wichita	KEDD	16	482-488
Massachusetts	North Adams	WMGT	74	830-836
"	Northampton	WNOH	36	602-608
Michigan	Benton Harbor	WHFB-TV	42	638-644
Minnesota	Austin	KMMT	6	82-88
Montana	Butte	KXLF-TV	6	82-88
New Jersey	Atlantic City	WOCN	52	698-704
New Mexico	Santa Fe	KTVK	2	54-60
New York	Elmira	WECT	18	494-500
North Carolina	Charlotte	WAYS-TV	36	602-608
"	Durham	WCIG-TV	46	662-668
North Dakota	Minot	KNDK	10	192-198
Oklahoma	Oklahoma City	KTVQ	25	536-542
"	Tulsa	KCEB	23	524-530
Oregon	Eugene	KTVF	20	506-512
"	Medford	KBES-TV	5	76-82
"	Salem	KPIC	24	530-536
Texas	Dallas	KDTX	23	524-530
"	Houston	KTVP	23	524-530
Utah	Salt Lake City	KUTV	2	54-60
West Virginia	Wheeling	WLTV	51	692-698

*ERP = (effective radiated power, kw.). **Call letters without TV suffix from application files and subject to change; except where included in calls such as KKTV or WTVT. . . = Call letters to be announced

NEW TV STATIONS ON THE AIR

(As of June 25, 1953)

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER* (IN KW.)
Arkansas					
Fort Smith	KFSA-TV	22	518-524	1.9	265
California					
Bakersfield	KFAY-TV	29	560-566	1.75	20.5
Fresno	KMJ-TV	24	530-536	1.85	33
Georgia					
Rome	WROM-TV	9	186-192	5.25	32
Idaho					
Nampa	KFXD-TV	6	82-88	11.8	.5
Michigan					
Battle Creek	WBKZ-TV	64	770-776	1.28	23.5
Pennsylvania					
Scranton	WGBI-TV	22	518-524	1.9	290
	WTVU	73	824-830	1.19	17.6
Wisconsin					
Madison	WKOW-TV	27	548-554	1.79	85

*From Station CP application.
The frequency of the video carrier = 1.25 + channel lower freq. limit.
Total number of television stations now on the air: 196 (44 of which are u.h.f.)

be an expert on
AUTO RADIO SERVICING!

Get the only authoritative compilation of its kind—complete Auto Radio Service Data coverage of all important models since 1946—in 3 great PHOTOFACT Manuals! All data complete, accurate, uniform—based on lab analysis of the actual auto radios covered. Helps you service *any* model quicker, easier—for greater profits. Get the complete Library!

VOL. 1. AUTO RADIO SERVICE MANUAL
Covers over 100 models made from 1946 to 1949 by 24 manufacturers. Each receiver is completely covered in uniform format; includes schematics, chassis photo views, replacement parts data, service hints, etc. All data based on actual lab analysis. 396 pages, 8½ x 11".
ORDER **AR-1.** *Only* **$4.95**

VOL. 2. AUTO RADIO SERVICE MANUAL
Covers 60 different chassis (40 models) used in 1948, 1949 and 1950 auto radio receivers. Authoritative, complete service data that makes your work quicker, easier and more profitable. 288 pages. 8½ x 11".
ORDER **AR-2.** *Only* **$3.00**

VOL. 3. AUTO RADIO SERVICE MANUAL
Covers 47 different chassis (80 models) used in 1950, 1951 and 1952 auto radio receivers. Absolutely the most complete, accurate and easy-to-use data available—uniform and practically presented to make you an expert on the repair of any auto radio. 288 pages. 8½ x 11".
ORDER **AR-3.** *Only* **$3.00**

SPECIAL OFFER!
All 3 Volumes, Yours for Only $9.95
Save on the Complete Library—see your PHOTOFACT Distributor

HOWARD W. SAMS & CO., INC.

Order from your Parts Jobber today, or write direct to HOWARD W. SAMS & CO., Inc.
2203 E. 46th Street, Indianapolis 5, Ind.
My (check) (money order) for $.... encl. Send:
☐ **AR-1 $4.95** ☐ **AR-2 $3.00** ☐ **AR-3 $3.00**
☐ **Complete 3-Volume Library $9.95**
Name ....
Address ....
City .... State ....

IMPOSSIBLE BUT TRUE!

SINGLE CHANNEL
5 ELEMENT DELTA-MATCH
YAGIS

ONLY
$2.00
each
LOTS OF 5

We know it's hard to believe, and we hardly believe it ourselves — but here it is, so make the most of it! These beautifully fabricated Yagis usually sell for 3 to 5 times our price!

Delta-Match principle insures flat response over entire channel bandwidth, providing maximum fidelity in both picture and audio portion of TV signal. These Yagis available for channels 2, 3, 4, 5 and 6, together with detailed instructions for cutting to channels 7, 8, 9, 10, 11, 12 or 13. Sorry, no less than 5 antennas of one channel. SPECIFY CHANNEL WHEN ORDERING.

Free with each order of 5 antennas 1 all-purpose hack-saw with blade and complete instructions for simple conversion of lower frequency Yagis to high frequency Yagis.

Stock No. YDM5—Packages of 5 Yagis. Wt. 40 lbs. .... Net $10.00

Concord Radio
55 Vesey Street, New York 7, N. Y.
Phone Digby 9-1132

Spectacular
KIT VALUES!

1,000 RESISTORS
½ watt, 1 watt, 2 watt, 5 watt. All new. 5 and 10% tolerance. Well assorted, popular values. Sensationally low priced!
1000 resistors...... $7.95

15 "FP" CONDENSERS
Single, double, triple section, 10 to 80 Mfd, 25 to 450 Volts. Sturdy plastic utility box. Wt. 3½ lbs.
No. FPK15—Kit of 15 condensers.............. $3.98

Condenser Treasure Chest
Surprise value! 75 paper, by-pass, mica, electrolytic, "FP," oil-filled, ceramicon, TV and bathtub condensers. Plastic Utility box. Wt. 10 lbs.
No. CTC75—Kit of 75 condensers................ $7.95

15 MICA CONDENSERS
Popular sizes, receiving type micas. 600 to 1000 volts test. Silver micas included. In plastic utility box. Wt. 1½ lbs.
No. MCK15—15 Micas............... $ .98
Same as above, 75 Micas...... $3.50

25 CERAMICONS
Fresh, new, popular assortment, worth twice the price! In sturdy plastic utility box, wt. 1 lb.
No. CCK25—25 Ceramicons. $1.49

Minimum order $5. 25% Deposit with C.O.D. orders, F.O.B., N. Y. C.

CONCORD RADIO,
55 Vesey St., New York 7, N. Y. Dept. N-7.
Please include my name on your special bargain mailing list, free of charge.
NAME..
ADDRESS....................................
CITY.................. ZONE... STATE.......

NOW—Real HI-FI
LOW COST TAPE RECORDING EQUIPMENT

PT-3M
DUAL-TRACK
DUAL-SPEED
3.75 & 7.5 i.p.s.
TAPE
MECHANISM
$59.75

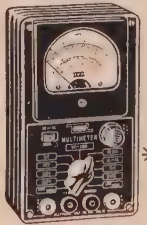
PRE-7 PRE-AMP
$39.75

This high quality, low cost tape recording combination by Pentron is ideal for all custom installation work. Can be mounted on slides, or built into present phono drawer. Easily built into your present system — or design your new system around this great pair. Frequency response 50 to 11, 500 at 7.5 i.p.s. Immediate delivery — from stock!

PMC—Portable Carrying Case with both units above, complete $114.50

ARROW ELECTRONICS
Audio Center
BEAUTY IN SOUND
65 CORTLANDT ST., NEW YORK 7, N. Y., DIGBY 9-4714

COMPARISON PROVES EICO® OFFERS GREATEST V-O-M values!



GET the MOST for your money — *Before you buy*, see chart below!
World-renowned *EICO*
VOLT-OHM-MILLIAMMETERS
*#536 KIT $12.90. Wired $14.90
#526 KIT (with 1% multipliers) only $13.90. Wired $16.90

VERIFY AT YOUR DEALER'S	EICO $12.90 up (KIT)	Co. A All Over $24.00	Co. B	Co. C	Co. D. EICO price range
31 ranges?	YES	No	No	No	No
Full-size 3-inch meter?	YES	Yes	Yes	Yes	No
400 ua sensitivity?	YES	Yes	Yes	Yes	No
Zero to 1 v. range on both AC and DC?	YES	No	No	No	No
5000 v. range on both AC and DC?	YES	Yes	No	Yes	No
AC/DC sens: 1000 Ω /v.?	YES	Yes	Yes	Yes	No
DC and AC Current Ranges?	YES	No	No	No	No
In KIT and Wired Form?	YES	Wired Only	Wired Only	Wired Only	Wired Only
Lowest cost in the Industry?	YES *See Above	No All over $24.00	No	No	No: EICO price range

Write for FREE Catalog MR-7 & name of local dealer.
Prices 5% higher on West Coast.

ELECTRONIC INSTRUMENT CO., Inc.
84 WITHERS STREET, BROOKLYN 11, N. Y.

Within the Industry

(*Continued from page* 18)

tion's group insurance plan . . . **WALTER M. JONAS** is the new vice-president in charge of production for *Radio City Products Company* of Pennsylvania. He was formerly production manager for the firm . . . **JOSEPH L. BALDWIN** is the new editor-in-chief of *Philco Corporation's* official dealer publication "Hi-Hat Club News" . . . **JOHN J. MUCHER,** prominent manufacturer and chairman of the board of *Clarostat Mfg. Co., Inc.,* died recently at the age of 70. He and his two brothers founded the firm in 1921 . . . **WILLIAM M. ALLISON** has been appointed as technical advisor to *Sprague Electric Co.* He has been with the firm for 20 years . . . **V. E. WOLLANG** is the new manager of distributor and export sales for *Oxford Electric Corporation* . . . **EDWARD J. GATELY, JR.** has been named project engineer for *Weathers Industries.* He was formerly associated with *Clifton Precision Products* and is connected with *Gately Development Laboratories* . . . **JOHN STEVENS** is the new director of manufacturing and production head of all television activities in the TV Division of *Hoffman Radio Corp.* He will be in charge of the company's three television plants . . . **HERBERT J. ALLEMANG** has been appointed vice-president in charge of planning for *Philco Corporation.* He will be responsible for the long-range planning of manufacturing facilities, organization, and operations of the company . . . **CHARLES E. BALZ** has been named sales manager of *Burgess Battery Company's* United States Battery Division. He has been assistant sales manager for the past two years and for the previous ten years advertising and promotion manager . . . **LAWRENCE E. PRISCAL** is the new director of purchases for *Sentinel Radio Corporation.* He has been with the firm for 21 years, the last several years as managing director of the service department.

* * *

BENJAMIN J. KATZ, who formerly headed his own advertising agency, has been named director of the newly-organized promotion and public relations department of the *Jerrold Electronics Corporation* of Philadelphia.

Mr. Katz was recently released from the Air Force where he served as public information officer for the Pacific Northwest Radar Command. Prior to his recall in April 1951, Mr. Katz spent nine years in Philadelphia advertising circles, interrupted during World War II by service with the Air Corps.

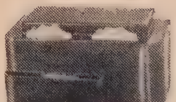
In his new post, he will be in charge of advertising, sales promotion, publicity, and public relations for the master television antenna systems manufacturer.

—30—

ELEVISION BOOSTERS AND CONVERSION KITS ON SALE AT McGEE

GENUINE STANDARD COIL T.V. BOOSTER $10.95

Not Surplus, But Right From the Factory

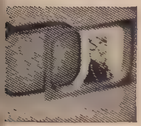


t Model B-51 Standard Coil Television Booster. McGee s another lucky purchase and as usual, passes the saving you. The famous Model B-51, 12 Channel Standard Coil ooster, which lists for $35.00, is offered to you for only 95 each. **Brand new, factory cartoned and fully guaranteed** McGee. This top quality single stage booster utilizes ed high frequency circuits, for improved performance on all els. Uses 6AK5 tube. Average gain, 6 to 7 volts on low els and 5 or 6 on high channels. No distorting of picture or sound. Has extremely noise factor. Continuous one-knob tuning and channel selector control switch for and by-passing 300 ohm lead-in to set. Modern design, dark brown plastic cabi- 8"x4¼"x4½. Made for 110 volt, 60 cycle AC operation. Shipping weight 5 lbs. B-51, Sale price, **$10.95** each, or buy 2 for only **$20.00.**

NGE AREA TV RECEPTION IS ETTER WITH OUR McMURDO SILVER TV BOOSTER $10.95—TWO FOR $20.00

the article on pages 52 and 53 of the December "Radio & TV News." You will see a booster like the McMurdo Silver Super Sonic was used for fringe area TV recep- We can't guarantee this unusual reception, but we will guarantee this booster to sensational value. Continuously variable inductance type tuner from channel 2 in- ng the FM band through channel 13. Self-powered for 110 volts AC operation. In- rates a 6J6 tube. Input for 300 ohm TV line and 300 ohm output to TV set. Sin- nob tuning. Attractive plastic case. McMurdo Silver Super Sonic TV-FM booster. No. GB-6B, shipping weight 5 lbs. Sale price, **$10.95** each or two for **$20.00.**

0 INCH CONVERSION KIT $29.95



YOU GET—

20HP4—20" PICTURE TUBE

20-INCH PLASTIC MASK

14 K.V. FLYBACK AND 70° YOKE

20" conversion kit includes a 6-month guaranteed 20HP4, 20" rectangular face picture tube, plus a 14,000 volt G.E. built high voltage flyback trans- er, plus a matched 70° cosine yoke, plus a 20" rectangular gold trimmed glas mask and suggested diagram. The picture tube is the latest electro-static type that requires no focus coil. Shipped via express or truck only. Ship. ht, 40 lbs. Stock No. 20-TP, net price, **$29.95.** Price with Raytheon or year guarantee picture tube, **$10.00** extra.

nch Conversion Kit $25.95 WITH G.E. TUBE

ch conversion kit: You get a 14- black face, 1 year guarantee G.E. 4 picture tube, a 70° deflection yoke matching 14,000 volt G.E. flyback a 14" plexiglas gold trim safety plus conversion instructions. Stock 4CC-G, Sale price, **$25.95.**

17-INCH CONVERSION KIT $25.95

You Get—17BP4A 17" Picture Tube

17-Inch Plastic Mask

14 K.V. Flyback and 70° Yoke

17-inch conversion kit with a 17BP4A, 17" rectangular blackface electro-magnetic focus picture tube with 6 months' guarantee, plus a matched 70° cosine yoke, a G.E. built 14,000 volt flyback and a 17" rectangular gold trimmed plexiglas mask and safety shield. Suggested diagram furnished. Shipping weight, 30 lbs. via Express or Truck only. Stock No. 17-4XL, 17" conversion kit. Sale price, **$25.95.** Kit Price with GE or Raytheon 1 year guarantee picture tube, **$5.00** extra.

SPEAKER AND BAFFLE SALE

8" SPEAKER AND BAFFLE $4.95

Stock No. 818, Tan leatherette covered, plywood slant type wall baffle: plus an 8" Oxford, 2.15 oz. Alnico 5 magnet PM speaker. A red hot McGee special for only **$4.95** each, or **$4.70** each in lots of 3 or more.

SPEAKER AND BAFFLE $6.95

No. CA-10. Tan leatherette covered ood slant type wall baffle; plus 10" aflux, 3.16 oz. Alnico V PM speaker. a few hundred to sell at **$6.50** each, 5.25 each in lots of 3 or more.

12" SPEAKER AND BAFFLE $7.95

Stock No. CA-12, Tan leatherette covered plywood slant type wall baffle; plus a 12" Quam, 4.64 oz. Alnico V magnet PM speaker. (Popular Adjustacone model.) A terrific McGee value for only **$7.95** each, or **$7.50** each in lots of 3 or more.

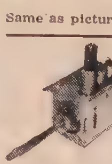
RCA 201E1 T.V. TUNER $7.95

Terrific buy on this RCA tuner. We have a limited quantity of the famous original 201E1, 13 channel completely wired and tested TV front end tuners. Ready to connect to your TV video I.F. strip. Offered at a sacrifice. Price was $44.00. Now only **$7.95** each, with tubes. Each tuner in good condition but has been repaired. Stock No. RCA-13P, TV front end tuner. Convertor coil type for separate sound as used in the famous 630 chassis. Complete with 3—6J6 tubes, **$7.95.** Specify shaft length desired, either 2" or 4".

RCA 201E-1 T.V. TUNER

Same as pictured above only new—with 2⅞" shaft. Stock No. 2Z01. Sale Price, **$11.95.**

3-TUBE SARKES-TARZIAN T.V. TUNER $9.95



This popular Sarkes-Tarzian Type 3 tuner is widely used. 13 channel rotary type switch with individually tuned coils. Price is complete with diagram and three tubes: 6C4 osc., 6BH6 R.F. and 6AG5 mixer. Regular factory cost is twice our price. Each tuner is wired ready to hook up to a video and sound IF strip. May be used with either inter-carrier or separate sound IF circuits. Has built-on convertor coil, built in fine frequency control. Sarkes-Tarzian TV tuner, with 3 tubes. Net price, **$9.95** each. Specify shaft length, either 2⅞" or 4¾".

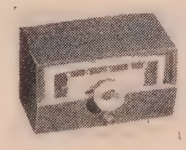
STANDARD COIL SUPER CASCODE TUNER $19.95 UHF STRIPS $7.50 EXTRA

The Cascode Circuit of the Standard Tuner offers a new development of this famous TV front end assembly which affords a 2-to-1 improvement in gain and a 35% to 50% reduction of noise over the pentode tuner. Other advances include: easy conversion to UHF reception by interchange of channel inductors; increased sensitivity for TV sets in fringe areas; elimination of booster use; and a high profit item for the serviceman as a replacement unit sale. Brand new factory TV-2000 TV tuner, compl. with tubes 6BK7 or 6BQ7 and a 6J6. Shaft length 3¼". Scoop UHF (specify channel) strips supplied in pairs for above cascode tuner, **$9.40** per set. UHF strips for other models of the Standard Coil tuners specify channel and series; either F, G, K, Q, R, H or M as printed on the tuner, **$7.50** per set.

UHF TELEVISION CONVERTER $34.95

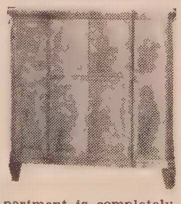
Sutco UHF television converter with built-in booster. Continuously variable for channels 14 thru 83. Built-in wide band VHF booster for channels 2 thru 13. Self powered for 110 volt, 60 cycle AC operation. Selector switch gives choice of VHF or UHF antenna. VHF antenna may be fed thru the broad band booster or direct to the TV set. Stock No. 21A, shipping weight 7 lbs. Net price **$34.95.**

REGENCY RC-600 $37.46



Carefully engineered and of highest quality construction. Features extreme stability, air dielectric in the tuning element, image rejection of VHF stations down 50 to 60 db. Converts all sets and is highly recommended for those having split sound and video. Tubes are 6AF4 oscillator, crystal diode mixer, 6BK7 dual triode IF amplifier and selenium rectifier. Front panel change-over switch for UHF or VHF. Input and output impedances 300 ohms. For 110 volt 60 cycle AC operation. Shipping weight 8 lbs. Stock No. RC-600, price **$37.46** each.

CAPEHART CABINET FOR 1000 SET—ONLY $99.95



99.95

BEAUTIFUL WALNUT

Beautiful, finest quality walnut combination radio-phono cabinet, 42" high, 42" wide and 22" deep. Made for Capehart's finest combination, selling for $900 and up. Cabinet cost manufacturer over $200.00. Has highly polished matched walnut panels. Made of ¾" material. Top 1⅛" solid stock. This cabinet weighs approximately 175 lbs. The changer radio and speaker grill all have hinged doors. Radio compartment on right hand side is 14" high and 11½" wide. Made to mount chassis vertically. Changer compartment is 14" high by 26½" wide. Large enough to hold any record changer or recorder mechanism. Front 10" of top over the changer compartment is hinged to fold back for easy access to the changer. Both radio and changer compartments come with uncut blank panels. Speaker baffle is cut for a 12" speaker and the speaker compartment is completely enclosed. Shipping weight, 275 lbs. Stock No. K-275W Capehart combination cabinet. Net price, **$99.95.** Walnut.

COMPLETE RADIO, TELEVISION AND AMPLIFIER KITS AT McGEE

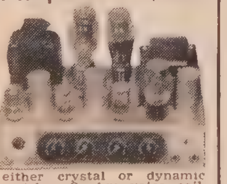
3-WAY PORTABLE KIT $15.95

New 1952 Model 3-way personal portable radio kit. Operates on 110 Volts AC-DC or 67½ B 1½ volt self-contained batteries. erette covered case size, 5½x5¾x8". ves broadcast 550 to 1650 KC. A ntional 2-gang superhet circuit with KC iron core IF's. Incorporates the super gain stick loop antenna. All d chassis. Lab. approved circuit— ned parts. Price includes all parts, , diagram, Alnico V PM speaker. A y quality kit. Stock No. PN-4T, ship- weight 7 lbs. The complete kit. Less ies, **$15.95.** 67½V. B, **$1.59;** 1½V. 9c extra.

Your Own ono-Mike adcaster $7.95

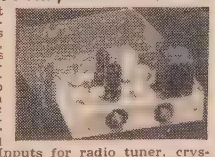
Model DE-6R. With imple kit, you can a 3-tube phono ator that also has ike input. Will cast over any ra- within your home, (about 75 feet) from to 1500 kc. Inputs for crystal mike or l phono pickup. Fader control fades mike to record. Ideal for a home P.A. n, baby listener and home entertain- A complete kit of parts including , Kit Model DE-6R. Net price, **$7.95.** RWT, wired and tested. Net price, 5. Crystal mike and desk stand, **$4.95** . Concealed microphone unit, only 1" ameter and ¼" thick. Specify hidden when ordering. Stock No. T-001. Net, 5 extra.

8-Tube Hi-Fi Amplifier Kit $29.95



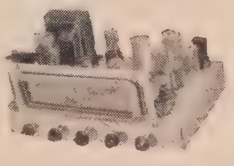
A complete kit, including tubes: 3-7E5, 2-12AX7, 2-triode plus rectifier diagram and photos. Inputs for radio tuner and any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output matches 8 ohm voice coil. Twin electronic bass and treble tone controls with range selector switch for either juke box quality with heavy bass response or brilliant symphonic range. Response 18 to 20,000 cps. 8 tube all triode amplifier kit, complete with tubes. Shipping weight 25 lbs. Model 7X5. Net **$29.95.**

10-Watt Hi-Fi Amplifier Kit $14.95



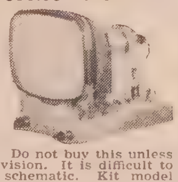
A complete kit of parts including tubes 12AX7, 12AU7, 2-50L6, plus rectifier, diagram and instructions to build a high fidelity twin tone control audio amplifier with bass and treble boost. Inputs for radio tuner, crys- mike and crystal phono pickup. Output matches 8 ohms. Response from 50 to 15,000 cps. Chassis ready punched. Ventilated cover. Straight forward circuit with twin triode gain stages and 2-50L6 tubes in push-pull. Size, 5¼" x 10" x 5⅝" high. Model AP-10R, ship. wt. 8 lbs. Sale price **$14.95.**

10-TUBE RADIO KIT $29.95



10 tube broadcast radio chassis kit, complete with tubes: 2-6SK7, 6SA7, 3-6SN7, 1-6SL7, 2-6V6 plus 5Y3 rectifier, diagram and instructions, 3 gang superhet with 8" slide rule dial. Chassis size, 12½"x10"x6½" high. Features push-pull 6V6 high fidelity audio. Output matches 3 to 8 ohm voice coil speakers. Inputs for G.E. variable reluctance or crystal phono pickup and crystal mike. Heavy duty power transformer. Model BK-R10 kit less speaker, shipping weight 18 lbs. Net **$29.95.**

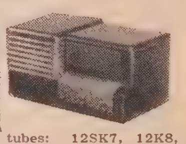
17, 20" T.V. Kit $59.95 Less Tubes



A complete kit of parts to build an AC transformer operated television chassis for use with a 16", 17" or 20" rectangular picture tube. The 12 channel Sarkes-Tarzian tuner is ready wired, as is the 4 tube video IF strip. Circuit is of the conventional design. Do not buy this unless you understand Television. It is difficult to wire. We furnish schematic. Kit model WH-20. Ship. wt. 40 lbs. less all tubes. Net **$59.95.** Cascode tuner $10.00 extra! 12" speaker $2.95 extra.

Kit of 22 tubes, less picture tube **$16.95.** 17" 17BP4A, **$19.95.** 20HP4, **$25.00.**

6-TUBE 2-BAND KIT $14.95



Popular with schools and colleges for training. 6 tube AC-DC, 2 band radio kit with plastic cabinet. Receives broadcast and 6 to 18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12SK7, 12K8, 12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Factory quality. Cabinet size 13"x6¾"x6¼". Shipping weight 12 lbs. Model ME6-2. Net **$14.95.**

5-TUBE AC-DC KIT $12.95

Model RS-5. A 5 tube AC-DC straight broadcast kit, housed in the same cabinet as ME6-2 above. Complete with tubes. Shipping weight 10 lbs., Net **$12.95.**

AC POWERED BROADCAST TUNER KIT $12.95

A self-powered, 3-gang superhet tuner kit with R.F. stage. This complete kit is furnished with a diagram, photos and tubes. 6BA6 R.F., 6BE6 oscillator R.F., 6BA6 I.F. detector, 6AL5 diode, AVC, plus rectifier. Connect to any audio amplifier. Ideal for use with our S-2020 or 7x5 amplifier kits. Chassis size, 9½x4x4½" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price, **$12.95.**

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

WHAT'S New in Radio

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page and the issue number, delay will be avoided.

FM-AM TUNER

Fisher Radio Corporation, 41 E. 47th Street, New York, N. Y. has recently introduced an AM-FM tuner which has been designated as the Model 50-R.

The new unit incorporates a two-band superheterodyne with completely independent r.f. channels for FM and AM. The FM section comprises a dual-triode, cascode, tuned r.f. stage for maximum signal-to-noise ratio and two i.f. stages followed by two cascaded limiters. These are combined with a *Foster-Seeley* discriminator to produce an *Armstrong* system.

Hum level, with the volume control at zero, is more than 100 db below two volts output and more than 90 db with volume control full on. The cathode-follower output permits output leads up to 200 feet in length.

The circuit uses fourteen tubes including the tuning eye and rectifier. The tuner is completely shielded, is housed in an etched aluminum chassis, and measures 14¾" wide, 8½" high, and 9¼" deep. It weighs 17 pounds.

"KLIPSCH" ENCLOSURE

G & H Wood Products has been licensed by *Klipsch & Associates* to manufacture and distribute a *Klipsch*-designed loudspeaker enclosure.

The units to be manufactured will be made under the *Klipsch* "Rebel 1V" patent and will be marketed through parts distributors in both assembled and kit form.

The new line will be advertised and promoted as the *Klipsch* "Rebel 1V" by *Cabinart,* the high-fidelity trademark of *G & H.*

ACOUSTICAL TILE

Tropicraft, 14 Sherwood Place, San Francisco 3, California is now marketing an acoustical tile which has been designed with appearance as well as performance in mind.

Known as "Tropi-Tile", the new product is made from fibrous glass surfaced with "Woven-Wood". The tile is available in ten textures and a variety of *"House and Garden"* colors as well as special decorator-colors-to-order.

The company invites inquiries regarding this new product and its applications.

TOWER ACCESSORIES

Alprodco, Inc. of Mineral Wells, Texas is currently offering two base units for use with television receiving towers.

The B1-WS base, for use with the company's standard or commercial 6-foot aluminum tower sections, fits peak or flat-top roofs and is made of heavy galvanized steel with flat feet that pivot to any angle. The base weighs 17 pounds.

The second unit, the MB-1R, is a universal base which permits roof mounting with or without fastening to the roof. Designed for difficult installations, the base is hinged, can be tilted at any angle, and can be mounted side, hip, or flat. Of sturdy construction, the unit weighs 7 pounds.

MARKER INJECTOR

A bypass marker injector to provide uniform markers at any point on visual response curves, in traps, or along the base line of a curve has been announced by *Scala Radio Co.* of 2814 19th Street, San Francisco 10.

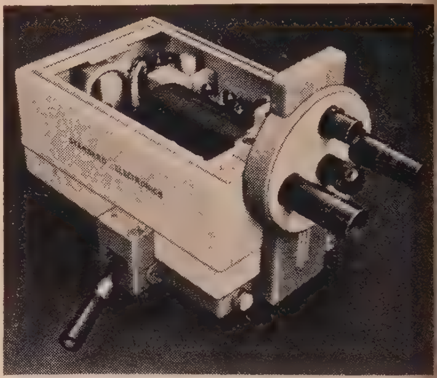
The SMI-53 "Super Marker Injector" has been designed to operate with any service sweep generator, scope, or marker generator. This unit is designed for application at video, i.f., and r.f. frequencies through 200 mc. When used with a low capacitance probe, the wide-band amplifier permits effective signal tracing in i.f. circuits. Thus, the instrument is suited to troubleshooting as well as alignment of TV receivers. It provides localization of dead or weak stages, and relative gain measurements.

The unit comes complete with an instruction manual and two coaxial test leads. A data sheet on the instrument is available from the company.

CAMERA CHAIN

Standard Electronics Corporation of 285 Emmett St., Newark 5, N. J. has introduced a new television camera chain, the SE-TE 468.

The new television camera provides operational characteristics and features which result in greater camera versatility and lower initial and operating costs, according to the company.



The new unit can be used for live, film, field work, stills, and test patterns. Stills and test patterns will not burn in. The pickup tube used in the camera is said to be 50 per-cent cheaper than other commonly used studio pickup tubes.

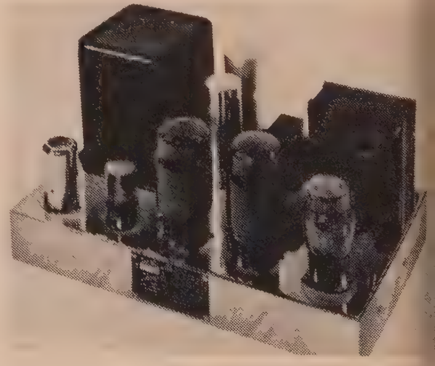
The camera features a single control for lens position and focus; full 8 mc. bandwidth; good depth-of-focus control; electronic view finder; four-lens turret using inexpensive, small diameter lenses; tally lights; and inter-communication.

The company will supply complete information on request.

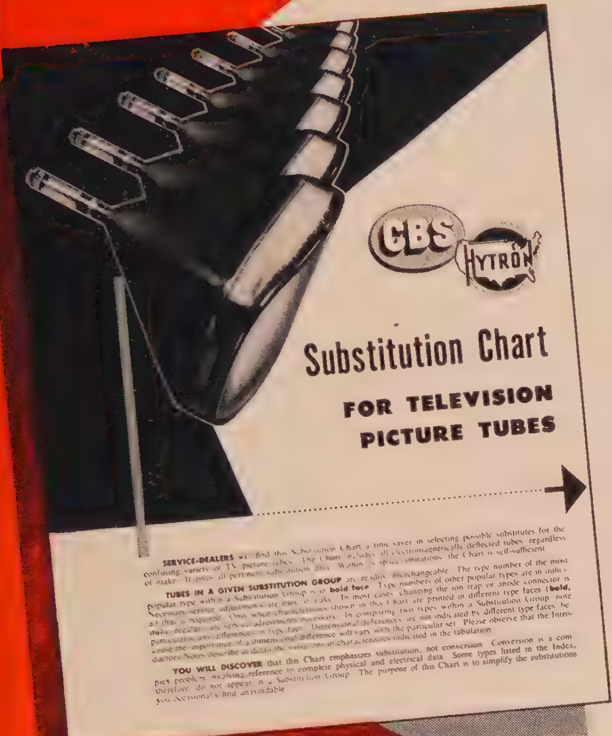
AUDIO EQUIPMENT

Radio Craftsmen, Inc., 4401 N. Ravenswood Ave., Chicago 40, Illinois is introducing two new pieces of audio gear to the trade.

The *Craftsmen*-500 has been designed primarily to be used as a separate audio power unit and can be conveniently installed in built-in locations. Its specifications include power output of 15 watts maximum; frequency response of ± .1 db, 20 cps to 20,000 cps and ± 2 db, 5 cps to 100,000 cps; power response 12.5 watts



How to make
PICTURE-TUBE SUBSTITUTIONS EASILY


CBS HYTRON
Substitution Chart
FOR TELEVISION PICTURE TUBES
SERVICE-DEALERS
TUBES IN A GIVEN SUBSTITUTION GROUP
YOU WILL DISCOVER

New CBS-Hytron Substitution Chart for Television Picture Tubes helps you pick logical substitutions easily, quickly. It's a cinch to use this complete, up-to-date Chart. An Index of types leads you to proper Substitution Group listing all readily interchangeable types. You pick an available type . . . with the least number of necessary service adjustments. That's it. No other references required. You save time . . . money. You need this indispensable CBS-Hytron TV Substitution Chart. Get it from your CBS-Hytron distributor. Or write direct today.

WHAT'S IN IT

1. *General Introduction* outlines scope and purpose.
2. *Introductory Notes* give details on tabulation.
3. *Typical Substitution* shows how to use Chart.
4. *Index* indicates Substitution Group for each type.
5. *Substitution Groups* narrow choice to logical substitutions.
6. *Basing and Outline Drawings* give basing and dimensional data.

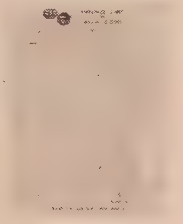
FEATURES

- All necessary data given for all electromagnetically deflected types, regardless of make.
- Directly interchangeable types indicated.
- Other popular substitutes and required service changes high-lighted and explained.
- Substitution, not conversion, emphasized.

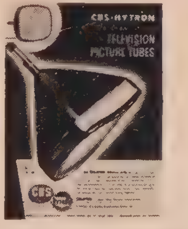
OT THESE HELPFUL GUIDES?

All are complete. Include all types, regardless of make. Give all pertinent data. Are free. Get yours today.

Miniature Guide includes 250 types, 111 basing diagrams. Indicates similar larger prototypes.

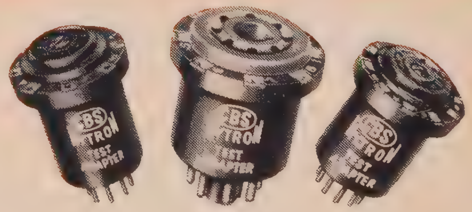


Crystal Diode Guide describes 92 types. Includes 7 dimensional diagrams. Indicates typical application for each type.



TV Picture-Tube Guide lists 164 types, 19 basing diagrams for all magnetically deflected picture tubes.

NOW 3
CBS-HYTRON TEST ADAPTERS



7-Pin Min.,
$1.45 Net

8-Pin Octal,
$2.25 Net

9-Pin Min.,
$1.75 Net

BY POPULAR DEMAND. You can now buy CBS-Hytron Test Adapters in all three popular sizes: 7-pin miniature, 8-pin octal, 9-pin miniature.

You can now test *all* sockets dynamically . . . "topside." Without wrestling with heavy chassis. Without disturbing wiring or parts. Just plug tubes into Test Adapters and Adapters into sockets. Presto, socket connections are topside . . . ready for your test prod. You check voltage, resistance, gain, intermittents, oscillation. Trace signals, etc. All the e-a-s-y topside way. Order *all three* Test Adapters from your CBS-Hytron distributor today.

New . . . Free DECAL

t just an identification. But a colorful decal t sells for you! *Sells* your magic ability to apture new-set sparkle. Let this decal pull tomers to you. Get it today from your CBS-tron distributor.

Manufacturers of
Receiving Tubes Since 1921

CBS-HYTRON Main Office: Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

CEIVING . . . TRANSMITTING . . . SPECIAL-PURPOSE AND TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

YOU SAVE . . . AT NEWARK
On These Audio Specials

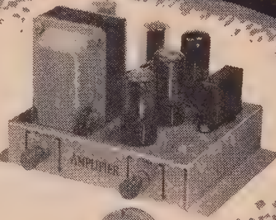
1 NEWARK LOW-COST AMPLIFIER
Compact 8-watt amplifier using 2-6V6 or 6K6 push-pull output tubes. Employs 6SN7 as Audio Driver and Phase Inverter; 5Y3GT is rectifier. Response, 50 to 12,000 cycles. Has continuously variable tone and volume controls. Outlet for AC phono motor plug on back. Output impedance, 8 ohms. Chassis size, 6x8½x5⅜". 7 lbs.
81F000. NET 21.50

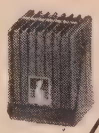
2 NEWARK COAXIAL SPEAKERS
Outstanding high-fidelity values! These low-cost speakers provide good high frequency response and bass reproduction. All have high-frequency tweeter unit and crossover network. Av. wt., 8 lbs.
83F994. 8" Speaker. Rated 6 watts. Has 2.15 oz. Alnico V magnet. Imped., 6 ohms. NET 8.95
83F995. 12" Speaker. Rated 12 watts. Has 10 oz. Alnico V Magnet. Imped., 8 ohms. NET 12.95
83F996. 15" Speaker. Rated 14 watts. Has 10 oz. Alnico V magnet. Imped., 8 ohms. NET 19.95

3 BRUSH BA-116 MIKE-PRICE REDUCED!
Originally sold for $8.61! Now available, while quantities last, at the low, low price of $5.95. This rugged microphone is ideal for tape recording, PA, or Amateur use. Response, 50 to 6,000 cycles. Output level, —53 db. High impedance. Shock-mounted crystal cartridge. Has ⅝"-27 thread. Brown. Wt., 1½ lbs.
54F350. Special 5.95
Order from Dept. R-7

Send for Catalog

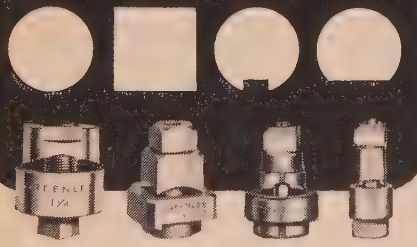
223 W. Madison St. NEWARK ELECTRIC COMPANY Chicago 6, Ill.





4 Save! Low Price!
WESTERN ELECTRIC
MODEL 134-B-3 HEARING AID
Regularly $185.00 Now 24.50
Brand new units, packed in original case. Complete with receiver, cord, battery cord less ear plug and batteries. Wt., 1 lb.
54G501. Special 24.50
BATTERIES FOR ABOVE
49F124. Burgess 8R .23
49F176. B'gess XX22 1.35

ROUND, SQUARE, KEY and "D" OPENINGS QUICKLY MADE with Greenlee Radio Chassis Punches



Save hours of hard, tedious work . . . cut accurate holes in chassis for sockets, plugs, controls, meters, panel lights, etc. with GREENLEE Punches. In 1-1/2 minutes or less make a smooth hole in metal, bakelite or hard rubber up to 1/16" thick. Easy to operate . . . simply turn with ordinary wrench. Wide range of sizes. Write for details. Greenlee Tool Co., 1887 Columbia Avenue, Rockford, Ill.

TOOLS FOR CRAFTSMEN GREENLEE

(Advertisement)

"Quick, Watson, the JENSEN!"

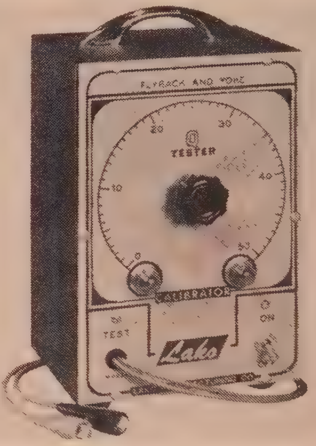
± 1 db, 10 cps to 50,000 cps; phase shift ± 15 degrees, 20 cps to 20,000 cps; total harmonic distortion less than .1% at 10 watts at mid-frequencies; power consumption is 105-125 volts, 60 cycles, 125 watts. Overall dimensions are 8" x 13½" x 7½".

The second unit is the "800", a compact phono equalizing and tone compressing system on a single chassis. Five front panel control knobs provide complete and flexible control of an entire custom high fidelity music system.

"Q" TESTER

Lako Manufacturing Co., 506 E. Townsend St., Milwaukee, Wisconsin has developed a test instrument for television servicing, the Model 400-A *"Q"* Tester.

With this instrument it is possible to test deflection yokes, width coils, and horizontal transformers without removing them from the set. The unit drives the test part at proper waveform and frequency and measures the output voltage. Since the output is a function of the *"Q"*, a single shorted turn will result in almost negligible output as compared with a good part.

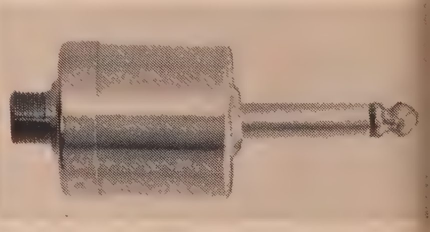


The company will supply full details on request.

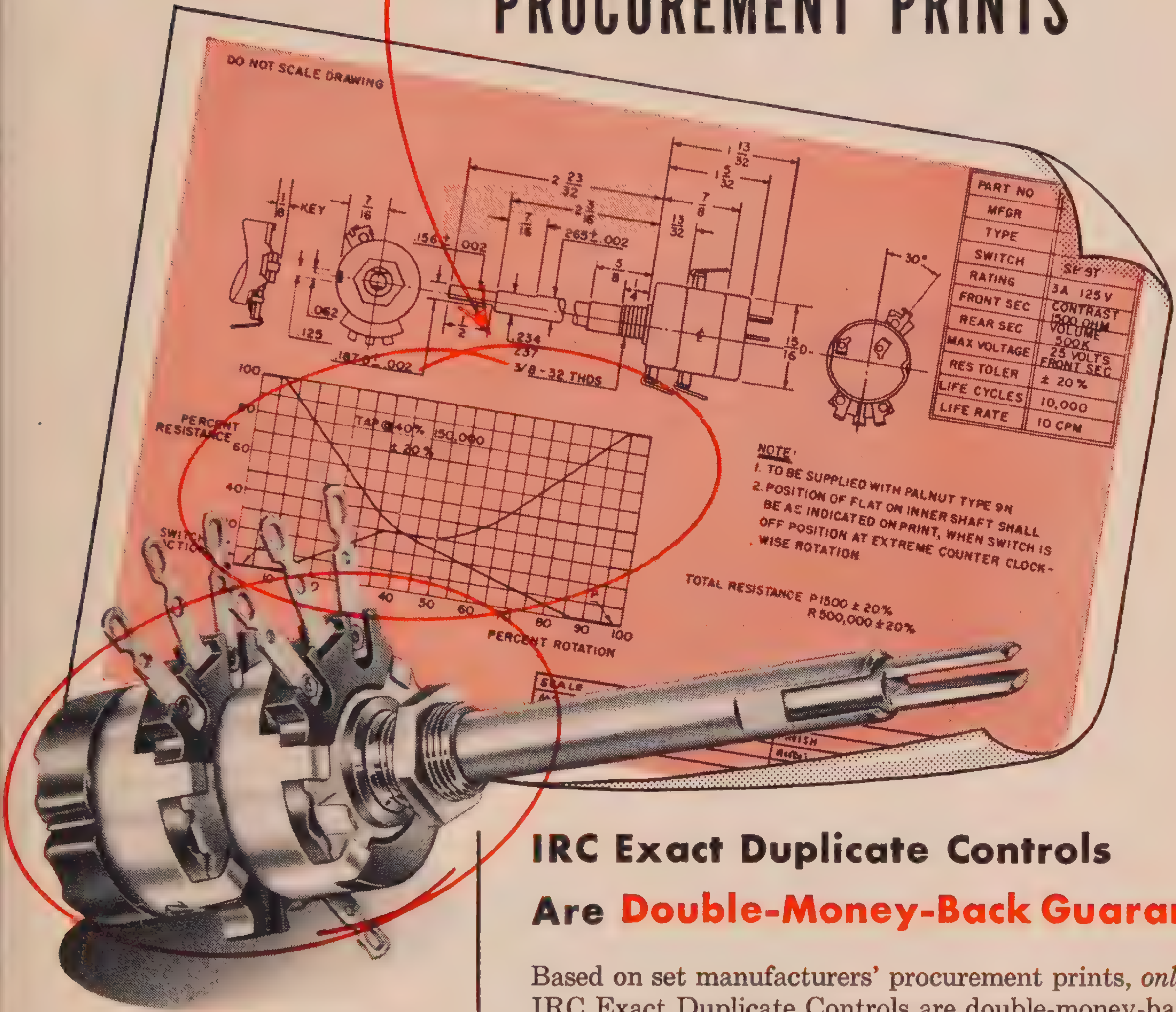
PERMOFLUX ADAPTER

Permoflux Corporation, 4900 W. Grand Ave., Chicago 39, Ill. has announced the availability of a new adapter which permits any of the company's binaural headsets to be used for conventional monaural service.

The input end of the adapter has a jack to receive the PL-68 type three-circuit plug of the binaural headset. The output end is a standard two-circuit PL-55 type plug which can be plugged into any conventional headset jack.



ASSURED ELECTRICAL ACCURACY BASED ON MANUFACTURERS' PROCUREMENT PRINTS


DO NOT SCALE DRAWING
KEY
3/8-32 THDS
PERCENT RESISTANCE
TAP @ 40% 150,000 ± 20%
SWITCH ACTION
PERCENT ROTATION
PART NO
MFGR
TYPE
SWITCH SP ST
RATING 3A 125 V
FRONT SEC CONTRAST 1500 OHM
REAR SEC VOLUME 500K
MAX VOLTAGE 25 VOLTS FRONT SEC
RES TOLER ± 20%
LIFE CYCLES 10,000
LIFE RATE 10 CPM
NOTE:
1. TO BE SUPPLIED WITH PALNUT TYPE 9N
2. POSITION OF FLAT ON INNER SHAFT SHALL BE AS INDICATED ON PRINT, WHEN SWITCH IS OFF POSITION AT EXTREME COUNTER CLOCKWISE ROTATION
TOTAL RESISTANCE P1500 ± 20% R500,000 ± 20%
SCALE
FINISH

ONLY IRC GUARANTEES ACCURATE ELECTRICAL OPERATION AND SATISFACTORY MECHANICAL FIT OR DOUBLE-YOUR-MONEY-BACK

Electrical specifications of this typical manufacturer's procurement print are exactly duplicated by IRC's QJ-412 control (shown). CONCENTRIKIT assembly includes P1-206 and R1-223 shafts with B17-109 and B13-133X Base Elements and 76-1 Switch.

IRC

Wherever the Circuit Says -\/\/\/-

IRC Exact Duplicate Controls Are Double-Money-Back Guaranteed

Based on set manufacturers' procurement prints, *only* IRC Exact Duplicate Controls are double-money-back guaranteed for accurate electrical operation. This firm guarantee applies to both IRC factory-assembled Exact Duplicates *and* universal CONCENTRIKIT equivalents.

Set manufacturers' electrical specifications are closely followed.

Resistance values are carefully selected to match.

Tapers are watched carefully; IRC doesn't arbitrarily substitute tapers to obtain wide coverage.

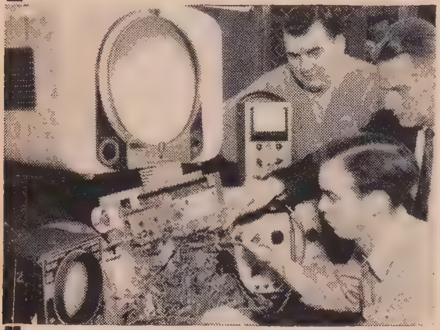
For exact duplicate controls of guaranteed accuracy, specify IRC. Most Service Technicians do.

INTERNATIONAL RESISTANCE CO.

415 N. Broad Street, Philadelphia 8, Pa.

In Canada: International Resistance Co., Ltd., Toronto, Licensee

BECOME AN
ELECTRICAL ENGINEER



Bachelor of Science Degree in 36 months.

Major in Electronics or Power. Now, prepare for a career in these rapidly expanding fields.

This school will prepare you to become an engineer, technician or service man. Previous military, academic or practical training may be evaluated for advanced credit.

Enter Both Radio and Television

In 12 months you can attain the *Radio-Technician's* certificate. An added 6 months course qualifies you for the *Radio-TV Technician's* certificate and the Degree of "Associate in Applied Science." The Technician's course is the first third of the program leading to a Bachelor of Science Degree in Electrical Engineering with a major in Electronics.

Also offered: 12-month Radio-TV service course; 12-month Electronics or Electro Technician Courses; 6-month Electrical Service Course and 3-month refresher and general preparatory classes.

Terms Open April, July, Oct., Jan.

Famous for its Concentric Curriculum. Faculty of specialists. 50,000 former students. Annual enrolment from 48 states and 23 overseas countries. *Non-profit. 50th year.* Courses approved for Veterans.

MILWAUKEE
SCHOOL OF ENGINEERING

MILWAUKEE SCHOOL OF ENGINEERING
Dept. RN753, 1025 N. Milwaukee
Milwaukee 1, Wisconsin

Send: ☐ Free 160-page Catalog describing Electrical Engineering Courses; ☐ Booklet on Careers in Radio-TV.

I am interested in______________________
name of course

Name________________________Age________

Address______________________________

City____ ______________Zone_____State__________

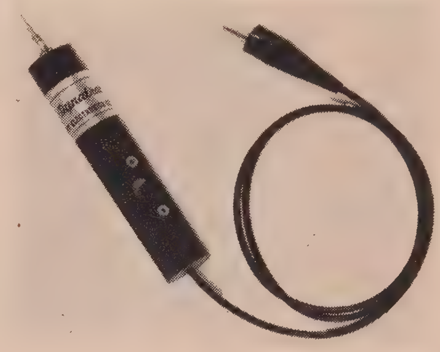
If veteran, indicate date of discharge__________

The adapter, Model BMA-1, was developed in response to requests from users of binaural headsets for a method of adapting their phones to standard service.

"DYNATRACER"

Century Electronics Co. of 8509 21st Ave., Brooklyn, N. Y. is currently offering a new test unit to the service fraternity.

The "Dynatracer" is a portable self-powered instrument designed to trace or inject signals through video, sound, sync, a.f.c., vertical, or horizontal sweep circuits.



With a flick of a switch, it will also trace voltages and locate open, shorted, or intermittent components. The new unit comes complete with operating instructions.

ANTENNA ROTATOR

LaPoint Electronics Inc. of Rockville, Conn. has released its new "Vee-D-X" antenna rotator to the trade.

The rotating unit features a unique gear train, positive antenna stop, special weather-resistant finish, easy line connection, and the ability to support over 200 pounds. The control console is decorator-styled and is available in heather green or cordovan mahogany. A unique control lever incorporates both compass and numerical reference points. The special control circuit requires no screwdriver adjustment.

MICAMOLD CONDENSERS

Micamold Radio Corporation, 1087 Flushing Ave., Brooklyn 37, N.Y. is now in production on a line of hermetically-sealed, metal encased "Ambirite" condensers.

The new units are designed to provide long and satisfactory operation in ambient temperatures up to 150 degrees C. They can be supplied with single and dual sections in standard capacitance values and voltage ratings in various case sizes.

The ability of these condensers to operate throughout the temperature range of −55 degrees C to +150 degrees C is attributed to the "Ambirite" dielectric. Capacitance change with temperature is small.

An engineering bulletin on these new units is available from the company on request.

BATTERY SOLDERING IRON

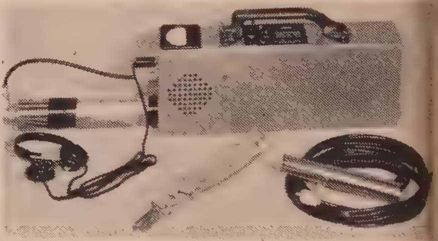
Hexacon Electric Co., 119 W. Clay Avenue, Roselle Park, N. J. has announced a soldering iron which can be connected to either 6 or 12 volts.

The new unit will generate any degree of heat required for soldering light or heavy work. A switch button controls heat. The iron will melt solder in 20 seconds.

The iron comes equipped with a nickel-chromium heating element, a 12 foot abrasion- and oil-resistant rubber heater cord, battery clips, and a non-breakable plastic handle. The over-all length is 12½ inches.

GEIGER COUNTER

The Radiac Co., Inc., 489 Fifth Avenue, New York 17, N. Y. has released a newly-engineered, ultra-sensitive Model 105-D "Prospectoscope" for radioactive mineral prospecting.



The Model 105-D can be used for prospecting from low flying aircraft, from a moving vehicle, or on foot, and also for probing drill holes to depths of 50 feet.

The unit is equipped with a 26" Geiger tube. It can be removed from the instrument and fitted to the 50 foot coaxial cable provided. It also features a standard-size beta-gamma Geiger probe, which is interchangeable with the giant-sized tube. An accurate meter having five ranges gives the prospector a broad selection of instrument sensitivities. A built-in speaker gives an aural indication of radioactivity.

VIBRATOR LINE

A new line of series drive vibrators specifically designed for long, dependable service in communications equipment has been introduced by *James Vibrapowr Company,* 4036 N. Rockwell St., Chicago 18, Ill.

Series drive has been incorporated in all of the company's replacement models where the original communications equipment has been designed to accommodate such an assembly. The mechanism gives steady, low-voltage starting throughout the extended life of the component.

The design, in addition, separates starting and driving functions from main vibrator contacts, insuring

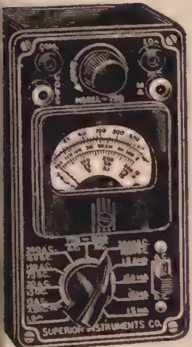
BUY TEST EQUIPMENT
ON THIS RADICALLY NEW
TIME PAYMENT PLAN

NO INTEREST!! - NO CARRYING CHARGES!!

USE CONVENIENT TIME PAYMENT ORDER BLANK BELOW

uperior's New
Model 770

VOLT-OHM MILLIAMMETER



Sensitivity—1000 ohms per volt

Uses latest design 2% accurate 1 Mil. D'Arsonval type meter. • Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time saving feature never before included in a V.O.M. in this price range. • Housed in round-cornered, molded case. • Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

SPECIFICATIONS:

6 A.C. VOLTAGE RANGES:
0-15/30/150/300/1500/3000 Volts.
6 D.C. VOLTAGE RANGES:
0-7.5/15/75/150/750/1500 Volts.
4 D.C. CURRENT RANGES:
0-1.5/15/150 MA. 0-1.5 Amps.
2 RESISTANCE RANGES:
0-500 Ohms. 0-1 Megohm.

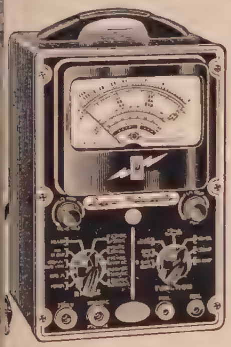
odel 770 is an accu-
te pocket-size V.O.M.
easures only 3⅛"x
⁄8"x2¼".

$14.90 NET

The Model 770 comes complete with self-contained batteries, test leads and all operating instructions.

perior's New
odel 670-A

SUPER-METER



A *COMBINATION* VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

es housed in rugged,
kle-finished steel cab-
complete with test
s and operating in-
ctions. Size 6¼"x9½"
".

$28.40 NET

ADDED FEATURE:
The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

Superior's Model 660-A—A NEW A.C. OPERATED

IGNAL GENERATOR

Provides Complete Coverage for A.M.—F.M. and TV Alignment

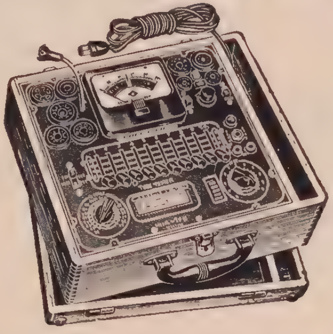
• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. • Accuracy and stability are assured by the use of permeability trimmed Hi-Q coils. • R. F. available separately or modulated by the internal audio oscillator. • Built in 400 cycle sine wave audio oscillator used to modulate the R. F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. • R. F. Oscillator Circuit; A high transconductance heptode is used as an R. F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. • A. F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a high-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. • Attenuator: A 5 step ladder type of attenuator is used.

Tubes used: 1—6BE6 as R. F. Oscil-
r, mixer and amplifier. 1—6BE6 as
io Oscillator. 1—6H6
ower Rectifier.
Model 660-A comes
plete with coaxial
e test lead and in-
ctions ....NET

$42.95 NET

Superior's New
Model TV-11

TUBE TESTER



• Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary. •.Uses no combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. • Free-moving built-in roll chart provides complete data for all tubes. • Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

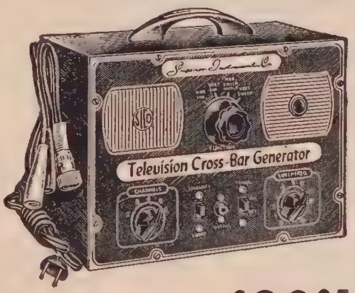
Operates on 105-130 Volt 60 Cycles A.C. Hand-rubbed oak cabinet complete with portable cover ....

$47.50 NET

Superior's New

TV BAR GENERATOR

THROWS AN ACTUAL BAR PATTERN ON ANY TV RECEIVER SCREEN!!



CONNECTS DIRECT TO ANTENNA POST

NO CONNECTION INSIDE RECEIVER

TV Bar Generator comes complete with shielded leads and detailed operating instructions ....Only

$39.95 NET

Features.—Can be used when no stations are on the air. • Provides linear patterns to adjust vertical and horizontal linearity • Provides vertical and horizontal sweep signals • Provides signal for testing video amplifiers.

NEW TIME PAYMENT PLAN
ORDER BLANK

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. B-63, 38 Murray Street, New York 7, N. Y.

Please send me the units checked below. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

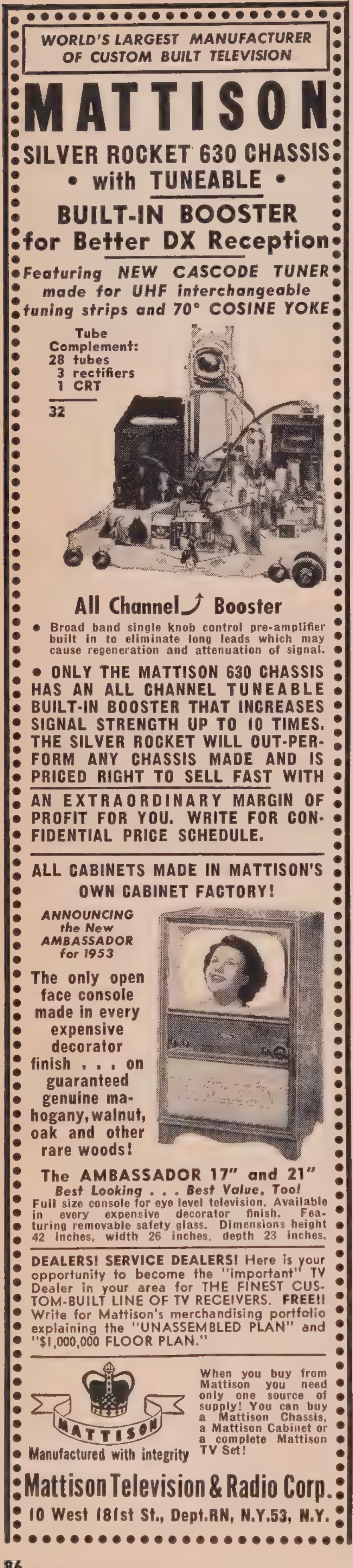
☐ **MODEL 770** ....Total Price **$14.90**
$2.90 down payment. Balance **$2.00** monthly for 6 months.
☐ **MODEL TV-11** ....Total Price **$47.50**
$11.50 down payment. Balance $6.00 monthly for 6 months.
☐ **MODEL 670-A** ....Total Price **$28.40**
$7.40 down payment. Balance $3.50 monthly for 6 months.
☐ **TELEVISION BAR GENERATOR**.........................Total Price **$39.95**
$9.95 down payment. Balance $5.00 monthly for 6 months.
☐ **MODEL 660-A** ....Total Price **$42.95**
$12.95 down payment. Balance $5.00 monthly for 6 months.
☐ I enclose $.................... as down payment.
☐ Ship C.O.D. for the down payment.

Signature...............................

Name ....

Address ....

City................................ Zone...... State....................



WORLD'S LARGEST MANUFACTURER OF CUSTOM BUILT TELEVISION

MATTISON

SILVER ROCKET 630 CHASSIS • with TUNEABLE • BUILT-IN BOOSTER for Better DX Reception

Featuring NEW CASCODE TUNER made for UHF interchangeable tuning strips and 70° COSINE YOKE

Tube Complement:
28 tubes
3 rectifiers
1 CRT
32

All Channel Booster

- Broad band single knob control pre-amplifier built in to eliminate long leads which may cause regeneration and attenuation of signal.
- ONLY THE MATTISON 630 CHASSIS HAS AN ALL CHANNEL TUNEABLE BUILT-IN BOOSTER THAT INCREASES SIGNAL STRENGTH UP TO 10 TIMES. THE SILVER ROCKET WILL OUT-PERFORM ANY CHASSIS MADE AND IS PRICED RIGHT TO SELL FAST WITH AN EXTRAORDINARY MARGIN OF PROFIT FOR YOU. WRITE FOR CONFIDENTIAL PRICE SCHEDULE.

ALL CABINETS MADE IN MATTISON'S OWN CABINET FACTORY!

ANNOUNCING the New AMBASSADOR for 1953

The only open face console made in every expensive decorator finish . . . on guaranteed genuine mahogany, walnut, oak and other rare woods!

The AMBASSADOR 17" and 21"
Best Looking . . . Best Value, Too!
Full size console for eye level television. Available in every expensive decorator finish. Featuring removable safety glass. Dimensions height 42 inches, width 26 inches, depth 23 inches.

DEALERS! SERVICE DEALERS! Here is your opportunity to become the "important" TV Dealer in your area for THE FINEST CUSTOM-BUILT LINE OF TV RECEIVERS. FREE!! Write for Mattison's merchandising portfolio explaining the "UNASSEMBLED PLAN" and "$1,000,000 FLOOR PLAN."

MATTISON
Manufactured with integrity

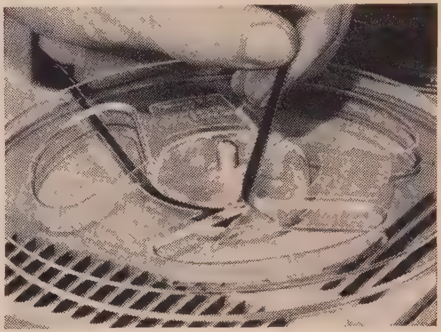
When you buy from Mattison you need only one source of supply! You can buy a Mattison Chassis, a Mattison Cabinet or a complete Mattison TV Set!

Mattison Television & Radio Corp.
10 West 181st St., Dept.RN, N.Y.53, N.Y.

greater dependability and additional hours of service.

A complete data sheet on these new models and other of the company's communications vibrators is available on request.

RECORDING REELS



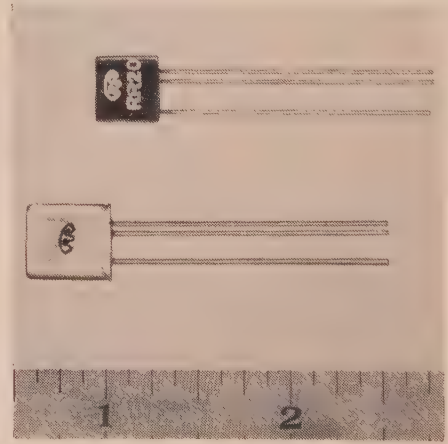
A new 7" plastic reel for use in magnetic recording with diagonal "V" slots for faster threading and a larger hub for more constant tape speed has been introduced by *Minnesota Mining and Manufacturing Co.,* 900 Fauquier St., St. Paul 6, Minn.

Designed to reduce errors in program timing, it is the first large-hub reel to accept all standard recording tapes, irrespective of thickness, without danger of tape spillage.

Two threading slots are provided on each side of the reel, including a unique "V" slot that reduces threading time by nearly one-third. More even winding of the tape on the reel is provided by reduced inside width of the reel and use of tapered flanges, thus minimizing the possibility of nicked edges and tape breakage.

JUNCTION TRANSISTORS

Radio Receptor Co., Inc. of 251 West 19th St., New York 11, N. Y. has added three types of "p-n-p" junction transistors to its line of germanium products.



The new units are sealed in a thin plastic sheet only .120" x .343" x .375". Leads may be soldered in or clipped to plug into a standard transistor or hearing aid socket. The asymmetrical lead spacing insures proper polarity and fits the standard subminiature socket.

Good performance is obtainable with as little as .5 ma. at 1.5 volt of collector voltage. Under these conditions the high gain type RR 20 has a current amplification of 40 and a power gain of 36 db. The general purpose type RR 14 and the economy type RR 21 have current amplification of 25. The latter two types have cut-off currents of only 10 microamperes and a noise figure of 22 db (1000 cps).

INSULATOR GROMMET

JFD Manufacturing Co., Inc. of 6101 16th Ave., Brooklyn 4, N. Y. is in production on a universal insulator grommet for all television downleads.

This polyethylene insert for standoff insulators will accommodate tubular and ribbon lead as well as oval, rectangular, and coaxial type transmission lines, thus facilitating the handling of lead-ins for both u.h.f. and v.h.f. installations.

SUBMINIATURE RESISTOR

Electra Manufacturing Co. of 2537 Madison, Kansas City, Mo. is currently offering a tiny deposited-carbon ⅛ watt resistor which has been especially designed for miniature work.

This "transistor" resistor is only 9/32 inch long and 5/64 inch in diameter. It is available in a range of resistances from 4 ohms to 250,000 ohms. It is rated at a maximum of 250 volts. Tolerances are ±1%, ±5%, and ±10%.

Additional details are included in the company's bulletin E-4 which is available on request. —30—

EW Speaker Enclosure

(*Continued from page* 43)

All of the preliminary design and testing work had been carried out using an 8-inch *Wharfedale* speaker. The problem now was whether or not the enclosure would perform equally well using other makes of 8-inch speakers. Several were tried, among them *Altec, Permoflux, Jensen,* and *University* units. The result of these tests seemed to indicate that any *good* 8-inch speaker could be used in this system.

The next problem seemed to be one of production. The positioning and size of fins (B) and (C) was such that to bolt the speaker securely in place was virtually impossible. The commercial version has solved this problem by slotting the sides (or top and bottom if the unit is used horizontally) of the cabinet so the fins can slide in and out, thus making the speaker readily accessible. The back panel of the cabinet is secured in place by means of wood screws.

The mechanical details of the cabinet, as given on page 43, show how comparatively simple this enclosure is in construction and belie its "big enclosure" performance. All-in-all, this unit has done a man-sized job on "location" recording and has performed well in the author's home.

—30—

U NBEATABLE quality is built into every Sylvania product. Even beyond that, ylvania quality goes back to its essential netals, chemicals, and materials.

ylvania quality is fundamental

ylvania grinds and formulates its own hosphors, and applies them by improved nethods which assure maximum uniformity and ine picture-tube performance. Sylvania raws its own high-quality tungsten filaments nd winds and tests its own coils.

Naturally, this far-reaching quality control esults in an enviable nation-wide reputation. oday 7 of the top 10 television set makers se Sylvania Picture Tubes and Receiving Tubes. Naturally, too, Sylvania quality pays off n fewer call-backs, more satisfied customers . . and *more profits for you.*

ou'll find your friendly Sylvania Distributor a mighty high quality man to do usiness with, too. Call him today!

Be sure to install Sylvania Picture Tubes and Receiving Tubes in all the sets you service. Your customers know about Sylvania's fine quality and they'll appreciate your selection of Sylvania products for their sets.

SYLVANIA

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

LIGHTING • RADIO
ELECTRONICS • TELEVISION

In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg.
St. Catherine St., Montreal, P. Q.

THESE BOOKS HELP YOU EARN MORE IN TV SERVICING

"How to Understand and Use TV Test Instruments"

Provides basic explanations of how each test instrument operates. Covers: VTVoltmeters, AM Signal Generators, Sweep Signal Generators, Oscilloscopes, Video Signal Generators, Field Intensity Meters, Voltage Calibrators. Describes each in detail; explains functions; tells proper use in actual servicing; shows how to avoid improper indications. Helps you get the most from your instruments; saves you time, helps you earn more. 148 pages, 8½ x 11". ORDER **TN-1**. *Only*....... **$3.00**

"TV Servicing Short-Cuts"

Describes a series of actual TV service case histories, giving step-by-step explanations of how the service technician localized and tracked down each problem. Shows how these frequently recurring troubles can be tracked down and solved in *any* set. Explains how to apply proper time-saving servicing techniques — gives you the successful experience of experts, to make your service work easier, quicker, more profitable. 100 pages, 5½ x 8½". ORDER **TK-1**. *Only*. **$1.50**

"Servicing TV in the Customer's Home"

Saves you time, work and chassis-hauling on outside TV service calls. Shows you how to make successful repairs on the spot using these methods: employing VTVM and capacitor probe to trace down trouble; "tube-pulling" to diagnose trouble by observing audio and picture effects; performance tests through analysis of test pattern; adjustment techniques developed for field servicing. Saves time, avoids chassis removal. 96 pages, 5½ x 8½". ORDER **TC-1**. *Only*....... **$1.50**

"Television Tube Location Guides"

VOL. 3. Shows tube positions and functions in hundreds of important TV sets. Helps save servicing time. Often, looking at the picture or listening to the sound, provides the clue to the trouble. Frequently, a tube failure is the cause. This guide, with its clear, accurate tube placement and function diagrams, makes trouble diagnosis and tube replacement quick and easy, *without removing chassis*. 192 pages. All new diagrams continuing coverage from Vol. 2. ORDER **TGL-3**. *Only*.................... **$2.00**

VOL. 2. Over 200 pages of tube placement diagrams not included in Vols. 1 and 3. ORDER **TGL-2**. *Only*........................ **$2.00**

VOL. 1. Over 200 pages of diagrams not in Vols. 2 and 3. ORDER **TGL-1**. *Only*............ **.$1.50**

"Photofact Television Course"

A full, easy-to-understand explanation of TV principles, operation and practice. Covers Cathode Beam Formations and Control, Beam Deflection Systems, Beam Mod. and Synch.; analyzes CR tubes, camera tubes, voltage supplies, saw-tooth generators, sync. circuits, control functions, antenna circuits, RF input tuning, IF systems, AGC, DC restoration, etc.; with full bibliography and glossary. 208 pages, 8½ x 11". ORDER **TV-1**. *Only*..... **.$3.00**

HOWARD W. SAMS & CO., INC.

Order from your Parts Jobber today, or write direct to Howard W. Sams & Co., Inc.
2203 East 46th Street, Indianapolis 5, Ind.

My (check) (money order) for $............ enclosed. Send the following books:

☐ TN-1 ☐ TK-1 ☐ TC-1
☐ TGL-3 ☐ TGL-2 ☐ TGL-1 ☐ TV-1

Name.................................

Address...............................

City............Zone....State...........

"Ferri-Loopstick" Receiver

(*Continued from page* 42)

5 of the 6 locals with ease and perfect clarity. Tried out in Baltimore, by M. M. Schuman, another old-timer who built the set described, this receiver tuned in 7 of the 8 locals there, clearly and consistently. Such reception, obviously, must be considered unusual, particularly in view of the few parts used.

No miracle is promised, however. The writer, who has spent some 30 years testing and building all types of crystal radios, merely feels that here is not a sensation, but a receiver that is just a little bit different, a little bit better than the sets the serious constructor has been accustomed to.

Of one thing the author feels certain, the hobbyist or experimenter who builds this set will find his time and effort well compensated, in the pleasure and entertainment this receiver will provide. Try building this when you have a free evening. —30—

TV Interference

(*Continued from page* 38)

filters are used to trap out individual interference frequencies.

Some interfering signals, like oscillator radiation from other TV sets, occur at the same frequencies as the desired signal. Rotating the antenna, shielded lead-in cable, and finally, realignment of the offending receiver are the only remedies here.

For the reader's convenience design data is given in Fig. 1 for a high-pass, 300-ohm filter, and for a 300-ohm tuned stub used as a narrow-band wave trap. Stub length is in inches.

—30—

FIRST AID

FROM A. E. Hutchins, radio officer aboard the SS Fullerton Hills, comes an interesting story regarding an unusual application for Matthew Mandl's "Demagnetizer" which appeared in the January issue of this magazine.

He reports that on a recent trip in mid-Mediterranean one of the able-bodied seamen got a steel splinter in his eye and suffered two days before Mr. Hutchins heard about it. The Pharmacist's Mate had been unable to dislodge the splinter and it had just about been decided that the man would have to be put ashore for hospitalization.

Mr. Hutchins remembered the "Demagnetizer" he had built and suggested that it might be strong enough to pull out the steel particle. They agreed that nothing could be lost by trying so they brought the man to the radio shack. Mr. Hutchins applied the magnet as close as possible and turned on the current. At once the seaman reported that the splinter was out. After the man's eye was rinsed out he returned to duty.

Our thanks to Mr. Hutchins for passing on this story. —30—

Scope as Voltmeter

(*Continued from page* 57)

of this voltage, but on the scope the peak-to-peak voltages are measured. The peak-to-peak voltages of any sine wave are related to the r.m.s. value as shown in Fig. 3. From this we see that 6.3 volts r.m.s. is equivalent to 17.8 volts peak-to-peak. When the 6.3-volt test point or some 6.3-volt filament point in the receiver is used as the calibrating voltage, the vertical amplitude should be adjusted until the signal covers 17 to 18 divisions. The most accurate system is to reduce the horizontal scope gain until only a narrow vertical strip is obtained as in Fig. 1. This makes it quite easy to center the signal vertically and adjust its amplitude until it covers just the right number of divisions. In Fig. 1, a 0.35-volt r.m.s. (1-volt peak-to-peak) signal was used and adjusted to cover 20 divisions. As shown, the signal is slightly larger than 20 divisions and further adjustments of the vertical gain control are needed. When an a.c. voltage is now measured, the calibration with the 1-volt signal is accurate down to 0.25 volt and up to about 2 volts. Although the height of the screen is more than 40 divisions, the edges no longer represent linear deflection and should not be used. If the signal is larger than 2 volts, the 6.3-volt r.m.s. calibration can be used or else the 1-volt signal can be adjusted to cover 5 or 10 divisions. In the latter case voltages up to 8 or 4 volts, respectively, can be measured. The main thing in making scope voltage measurements is to adjust the calibrating voltage for convenient interpretation. Making 1 volt equal to 1, 2, 5, or 10 divisions helps to avoid errors in reading the measured voltage. For the reader's convenience Fig. 2 lists the most frequently used calibrating voltages by r.m.s. and peak-to-peak value.

There is one limitation on a.c. measurements that should be mentioned and that concerns frequency. Many service-type scopes have a linear frequency response in the vertical section up to 500 kc., others go up to 2 or 3 mc. For a.c. voltage readings only the linear portion can be used and frequencies at which the amplifier gain drops 1 or more db cannot be measured by using a 60 cps calibrating signal. —30—

TRANSISTOR CONTEST

RAYTHEON is sponsoring a transistor application contest which offers a total of $10,000 in prizes to the lucky winners.

The contestant is required to build a piece of equipment using one or more of the company's CK722 transistors. He then submits a photograph, a completed entry blank, and a 500 to 1000 word article describing the equipment to the company.

Full details and official entry blanks are available from all Raytheon tube distributors. —30—

Spot Radio News
(*Continued from page* 26)

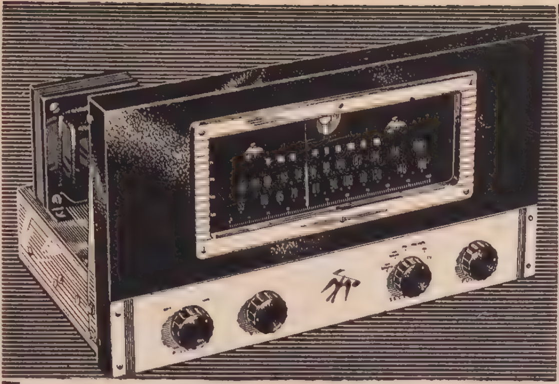
When and if a drill is held, listens will hear the following message: Ve interrupt our normal program to operate in security and civil defense easures as requested by the United ates Government . . . This is a nelrad radio alert. Normal broadsting will now be discontinued for indefinite period . . . Civil defense formation will be broadcast in most eas at 640 or 1240 on your regular dio receiver."

When stations are alerted, they will obliged to discontinue the normal ogram, cut the transmitter carrier sound carrier on TV, for approxiately five seconds, then return carr to the air for approximately five conds, and cut carrier again for anher five seconds. This step will be llowed by returning the carrier to e air and broadcasting a 1000-cycle eady-state tone for 15 seconds; the nouncement then follows.

Eastern, central, and western zones ve been assigned to the *C* plan. In e east, A. Prose Walker is in charge, rving as FCC liaison officer, Eastern r Defense Force, at Stewart Air orce Base, Newburgh, New York. nest C. Thelemann has been given e central zone base. He is also an CC liaison officer, representing the ntral Air Defense Force, P.O. Box 8, Kansas City, Missouri. On the est Coast, Robert D. Linx is in arge at the Hamilton Air Force se, Hamilton, California.

IE WHITE HOUSE was also reprented at the broadcast conclave, in e form of a special letter from the esident to NARTB prexy, Harold E. llows. Said the President: "Our tion's vast broadcasting system, deloped over a period of only three cades, testifies again to the extraornary achievements that are possible a free and competitive economy. day, radio reaches into ninety-eight r-cent of the homes of America. levision may soon match that recl . . . This vast coverage imposes impressive responsibility upon those erating our broadcasting stations d directing network activities . . . inform the people fully, fairly, and ely, to hearten their spirit with althy entertainment, to encourage every possible way aspiration ward a better state for all mankind these are the high purposes to hich you are dedicated . . . I am nfident that the nation's broadsters will continue to meet this exaordinary responsibility."

NE OF THE HIGHLIGHTS of the icific-coast meeting was the appearce of Madame Commissioner Frieda nnock pleading for more funds for e Commission so that more hearing aminers can be retained to process ore station authorizations. Declar-



IT'S HERE!
IT'S THE BEST!

MODEL 50-R

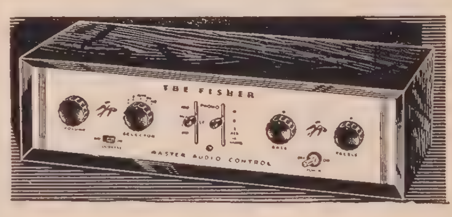
FISHER
FM-AM TUNER

■ We haven't the space here to give you *all* the details on the new FISHER 50-R. However, we *can* tell you *there is no other like it,* anywhere, and at any price! FEATURES IN BRIEF: Armstrong system, dual limiters, two IF stages, cascode RF stage, full limiting even on only 1 microvolt signal. Sensitivity, 1.5 microvolts for 20 db of quieting. AFC on switch and adjustable for locality. *Adjustable selectivity on AM.* Separate AM and FM front ends, fully shock-mounted. Response uniform, 20 to 20,000 cycles. Distortion less than 0.04% for 1 volt output. Hum level more than 100 db below two volts output. Cathode follower output. Fully shielded; bottom cover. Aluminum chassis. 12 tubes plus tuning eye and rectifier. Self-powered. **$159.50**

"Of the very best!" —HIGH FIDELITY MAGAZINE

FISHER PREAMPLIFIER EQUALIZER

■ "Either of these two units is of the very best," says *High Fidelity Magazine* of the FISHER 50-C Master Audio Control and 50-A Amplifier. The 50-C can be used with *any* amplifier. Intermodulation distortion is virtually unmeasurable. Complete phono equalization, loudness control, 5 inputs, 5 input level controls, cathode follower outputs. Self-powered.
Chassis, **$89.50**
With cabinet, **$97.50**

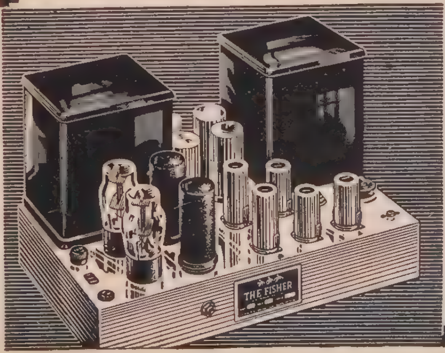


FISHER 50-WATT AMPLIFIER

■ THE FISHER Laboratory Standard Amplifier Model 50-A is, beyond a shadow of a doubt, *the world's finest all-triode amplifier*—and yet moderately priced. FEATURES: High output—less than 1% harmonic distortion at 50 watts (.08% at 10 watts.) Intermodulation distortion below 2% at 50 watts. Uniform response within .1 db, 20-20,000 cycles; 1 db, 5 to 100,000 cycles. Hum and noise more than 96 db below full output. Quality components and beautiful workmanship throughout. **$159.50**

Write for illustrated brochure

FISHER RADIO CORPORATION
39 EAST 47th STREET • NEW YORK



ing that the Commission is . . . "second only to the atomic Commission in importance to the country's welfare . . ." she wondered why Congress insisted on slicing their budget, taking millions off the appropriation request. The extra $300,000 received from Congress was a mere trickle, she added, because it represented but a small return of the moneys deleted from the budget request. "Our budget was less last year than in 1946 when we had no television stations to speak of," Madame Commissioner reminded her listeners. "We need more of everything at the Commission," she emphasized. "Not only examiners, but engineers and lawyers, too."

Earlier, in a letter to all Senators, a demand for more FCC dollars was also made by Senator Johnson. He pointed out that billions of dollars of new business can be created for the nation's dealers, wholesalers, and manufacturers by alloting more money to the Commission, so that they could get more stations on the air. Not only do TV and radio people profit from new stations, he added, but countless others who either supply the radio-TV industry or sponsor programs and thus stimulate sales of other merchandise. The Senator noted that it would not cost the Government any more to have more new TV station applications processed this year and next, than it would to have such processing parceled out over a five or ten-year period.

According to the Senator, at least $8-billion more new business would result in a relatively short period of time, if more station construction authorizations were cleared, thus hastening broadcast operation.

SENATOR GEORGE A. SMATHERS also joined the drive for accelerated processing. But he claimed that speedier hearings would solve the problem. Too much time, he said, is spent in examinations. Hundreds of competing applications are still in the files, the Senator declared. This was inexcusable, he pointed out. So determined was the Senator to get action, that he introduced a resolution asking the Senate Commerce Committee to investigate this condition and determine just what must be done to get those contested cases out of the files. In his opinion the real need for stations is . . . "in areas where we find several applicants competing for the right to televise over the two or three channels which have been authorized in that area." It has been well established, he said, that there are many single-station applicants who have no intention of building a television station, and only intend to . . . "hold on to a license until he can dispose of it at a profit, or until the population in that area is sufficient to justify his erecting a television station."

BROADCASTERS' and TELECASTERS' income in 1952 rose sharply according to preliminary estimates released by the

MOST POWERFUL FRINGE AREA CHASSIS

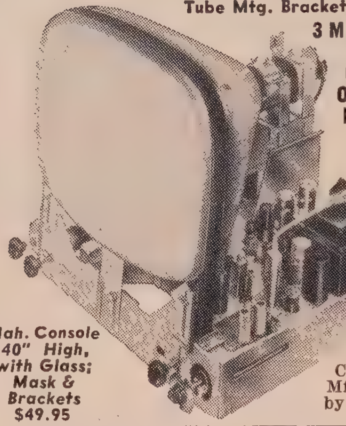
THE NEW 1953 CO-CHANNEL "630 FA-2*"

With Genuine Armstrong FM Sound System

The CHASSIS That Television Engineers and Servicemen Are Buying for Themselves . . .

Tube Mtg. Brackets $6.50

3 MONTHS
RMA
GUAR.
ON ALL
PARTS



Mah. Console 40" High, with Glass; Mask & Brackets $49.95

Chassis
Mfr. Lic.
by R.C.A.

CHECK THESE EXCLUSIVE FEATURES

• 10 WATT push-pull audio output. Frequency range from 40 to 12,000 cycles • Standard Coil Cascode Tuner prevents radiation • Retrace Blanking Circuit allows you to raise the brightness without the annoying vertical retrace lines • Heavy duty front focus control • Automatic gain control potentiometer allows you to adjust the threshold sensitivity as low as 4 microvolts & still keep the full 4MC band width • Improved sync amplifier • Improved automatic brightness control • Set aligned for 21.9 MC. New Ham band will not interfere • Improved fused high voltage power supply gives full 14.5 KV under load. Will handle all picture tubes up to 24 inch with full sweep • Improved video amplifier has a gain of 40 • All moulded plastic condensers give long life & trouble-free operation • Easily adapted to new UHF stations in 2 minutes by just changing a strip in the tuner • Extra heavy duty power transformer with large safety factor • 6CB6 tubes in Video IF to give full gain • Extra filtering in power supply for hum & ripple-free operation • Phono Connection & switch on chassis allows you to play your phonograph or tuner through the built-in 10 watt hi-fidelity amplifier • Extra heavy duty focus coil, which runs cool • Full focus cosine yoke.

Send for New FREE TV Parts & HI-FI Catalog

THE ONLY CHASSIS WITH PUSH-PULL AUDIO OUTPUT AT

$169.95 Less C.R. Tube and Brackets

Complete with 12" ROLA Hi-Fi Speaker (Fed. Tax Incl.)

Detailed Service Manual & Schematic—$1

TV GOLD PLASTIC MASKS

16" and 17"..$ 4.95
20" and 21"..$ 7.95
24" $14.95

OVER 100 BARGAIN-PRICED CABINETS FOR TV & AUDIO INSTALLATIONS . . . Send for FREE folder and price list. Full line table models, consoles, consolettes and TV-Radio Phono combinations. Many styles, Mahogany, blonde, etc.

TV PICTURE TUBE SALE

Standard Brands • Factory New

GUARANTEED 1 FULL YEAR

- 16" Tube. **$19.95**
- 17" Tube. **$27.95**
- Ring and Sleeve for 24" . . . **$7.50**
- 20" Tube. **$34.95**
- 21" Tube. **$39.95**
- 24" Tube. **$79.95**

All merchandise is brand new, factory fresh & fully guaranteed. Mail & phone orders filled upon receipt of certified check or money order for $25 as deposit on TV chassis. 20% on other items. Balance C.O.D., F.O.B. N. Y. Prices & specifications subject to change without notice. No Fed. taxes to pay. Prices lower than OPS

AIREX RADIO CORP.

SHOWROOM: 171 Washington St., N. Y. 7, N.Y.
Grammercy 7-9245
MAIL ORDER DEPT.: 400 Lafayette St., N.Y. 3

ARKAY

world's finest radio kits

Write for free Brochure

RADIO KITS, INC., 120 Cedar St., N. Y. 6

GET INTO TV SERVICING

Send for free 24-page illustrated booklet which tells you how to become a successful TV technician. America's leading TV servicing school offers you a specialized training program that omits non-essential math & design theory. You concentrate on radio & TV servicing only. You get professional training & experience right in our fully-equipped shops & laboratories. Send for this booklet today. Write **Dept. R-73.** No obligation—no salesman will call.

Approved for Veterans

WESTERN TELEVISION INSTITUTE

341 W. 18th St. Los Angeles 15, Calif.

PAY LESS FOR TUBES

INDIVIDUALLY BOXED • FULLY TESTED • EACH TUBE GUARANTEED FOR SIX MONTHS

Type	Price	Type	Price	Type	Price	Type	Price
1B3GT	$ .69	6AS5	$ .50	6K6GT	$ .41	12AZ7	$ .70
1H5GT	.46	6AT6	38	6L6G	.80	12BA6	.45
1L4	.57	6AU6	.43	6L6GA	.80	12BE6	.47
1N5GT	.57	6AV6	.38	6S4	.46	12BH7	.63
1R5	.56	6B4G	.96	6SA7GT	.52	12BZ7	.75
1S5	.47	6BA6	.45	6SJ7GT	.47	12SA7GT	.52
1T4	.56	6BC5	.53	6SK7GT	.50	12SK7GT	.50
1T5GT	.71	6BD5GT	.89	6SL7GT	.62	12SL7GT	.61
1X2	.67	6BE6	.47	6SN7GT	.54	12SN7GT	.54
3Q5GT	.65	6BF5	.60	6SQ7GT	.42	12SQ7GT	.44
3S4	.55	6BG6	1.34	6T8	.78	19BG6	1.39
3V4	.56	6BH6	.57	6U8	.85	19C8	.94
5U4G	.43	6BJ6	.48	6V6GT	.46	19T8	.79
5V4G	.73	6BK7	1.10	6W4GT	.45	25BQ6	.89
5Y3G	.34	6BL7	.83	6W6GT	.57	25L6GT	.48
5Y3GT	.30	6BQ6	.89	6X4	.34	25Z6GT	.42
6AB4	.46	6BQ7	1.10	6X5GT	.33	35A5	.48
6AF4	1.40	6BZ7	1.10	6Y6G	.59	35B5	.47
6AG5	.54	6C4	.34	7N7	.52	35C5	.47
6AK5	.95	6CB6	.53	12AT6	.38	35L6GT	.47
6AK6	.63	6CD6	1.85	12AT7	.68	35W4	.31
6AL5	.40	6F6GT	.45	12AU6	.43	35Z5GT	.30
6AN4	1.30	6H6GT	.49	12AU7	.55	50B5	.47
6AQ5	.46	6J5GT	.40	12AV6	.38	50C5	.47
6AQ6	.42	6J6	.62	12AV7	.80	50L6	.47
6AR5	.38			12AX7	.61	117Z3	.39
						117Z6	.68

Motorola Ballast Tube #17A485459....... .30

Each tube is performance-proven. 25% deposit must accompany all orders. Balance C.O.D. All prices F.O.B., N.Y.C. If remittance is made with order, you can deduct 2%. $1.00 handling charge for orders under $10.00. Subject to Prior Sale. Importer inquiries invited.

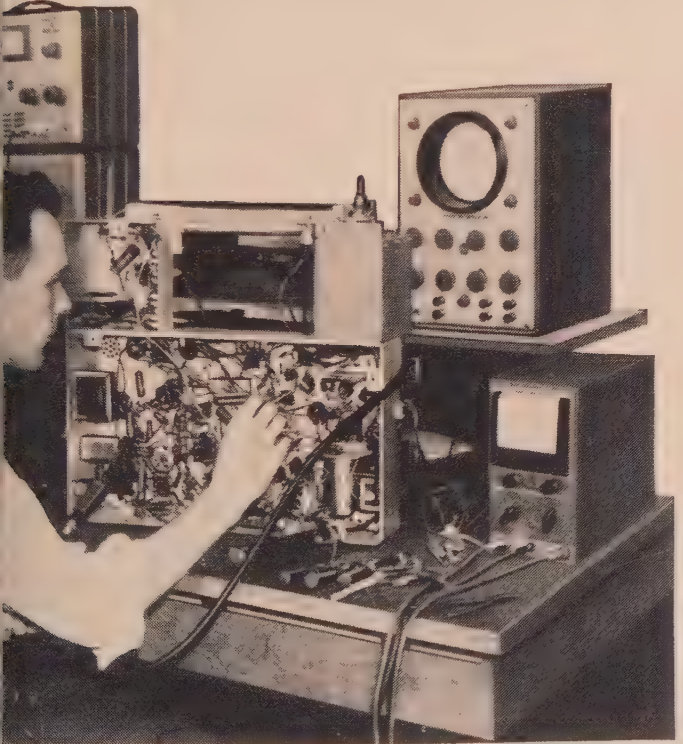
PHILLIPS TUBE COMPANY

2281 Nostrand Ave.
BROOKLYN 10, N. Y.
CLoverdale 3-8010-1-2

START ON THE ROAD TO SUCCESS
Study the RCA TV Servicing Course in your spare time

ARE YOU SATISFIED with the position you now hold? Do you feel ou're worth more money? Are you pleased with yourself, your ork, your associates . . . and your future? What does the next ear hold for you . . . and the year after that?

Are you content merely to plod along through the best years of our life . . . or do you want to get into more pleasant work . . . old a well-paid job . . . perhaps establish your own business?



If you are looking for a REAL opportunity . . . If you want t GROW with a GROWING INDUSTRY . . . If you want to grasp th success that should be yours, *then we say to you, study TV Servicin*

Everyone knows that Television is the fastest growing industr today. Opportunities are going begging for men who have th training and ability to grasp them. Now *is the time to start on th road to success in TV Servicing.*

Study at Home in your spare time

The RCA Institutes Home Study Course in TV Servicing is eas to learn. You progress rapidly, step by step, as you learn th procedure of servicing and trouble-shooting TV receivers and in stalling TV antennas. Hundreds of pictures and diagrams help yo understand the how-it-works information and the how-to-do- techniques.

A Service of Radio Corporation of America

The RCA Institutes TV Servicing course was written and planne by instructors with years of specialized experience in training mer You get up-to-the-minute information, too, because you stud right at the source of the latest developments in Television. You lessons are carefully examined and accurately graded by competer teachers who are interested in helping YOU to succeed.

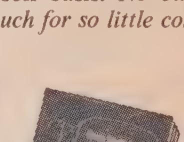
RCA Institutes is licensed by the University of the State New York . . . an affiliate member of the American Society fo Engineering Education . . . approved by leading Radio-Televisio Service Organizations.

It costs so little to gain so much

RCA Institutes makes it easy for you to take advantage of th big opportunities in TV Servicing. The cost of the TV Servicin Home Study Course has been cut to a minimum. You pay for th course on a pay-as-you-learn unit lesson basis. *No other hom study course in TV Servicing offers so much for so little cost to you*

RCA Institutes conducts a resident school in New York City offering day and evening courses in Radio and TV Servicing, Radio Code and Radio Operating, Radio Broadcasting, Advanced Technology. *Write for free catalog on resident courses.*

SEND FOR FREE BOOKLET—Mail the coupon—today. Get complete information on the RCA INSTITUTES Home Study Course in Television Servicing. Booklet gives you a general outline of the course by units. See how this practical home study course trains you quickly, easily. Mail coupon in envelope or paste on postal card.



MAIL COUPON NOW!

RCA INSTITUTES, INC., Home Study Dept. RN753
350 West Fourth Street, New York 14, N. Y.

Without obligation on my part, please send me copy of booklet "RCA INSTITUT Home Study Course in TELEVISION SERVICING." (No salesman will call.)

Name
(please print)

Address

CA INSTITUTES, INC.

RADIO Surplus Buys

CRYSTALS

. . . in FT 241-A Holders—½" Pin SPC. Marked 54th OR 72nd Harmonic MC Freq. Listed below by fundamental frequency with fractions omitted.

500 KC Crystals ea. $1.95

1000 KC Crystals
200 KC Crystals ea. $3.95

370
372
374
375
376
377
379
380
381
383
384
385
386
387
388
390
391
392
393
394
395
396
397
398
400
401
402
403
404
405
406
407
408
409
411
412
413
414
415
416
418
419
420
422
423
424
425
426
427
429
430
431
433
434
435
436
437
438
440
441
442
443
444
445
446
447
448
450
451
452
453
454
455
456
457
458
459
461
462
463
464
465
466
468
469
470
472
473
474
475
476
477
479
480
481
483
484
485
486
487
488
490
491
492
493
494
495
496
497
498
501
502
503
504
505
506
507
508
509
511
512
513
514
515
516
518
519
520
522
523
525
526
527
529
530
531
533
534
536
537
538
540

$1.00 EACH

10 for $8.00, Postpaid

FOLLOWING CRYSTALS AVAILABLE IN
FT 243 HOLDERS ½" PIN SPACING

4165
4240
4280
4310
4330
4335
4350
4370
4440
4445
4540
4635
4710
4880
4980
4995
5035
5127.5
5205
5285
5435
5485
5587
5660
5730
5852.5
5875
6073.3
6140
6350
6525
6550
6700
6825
6875
6975
7350
7450
7750
7875
7950
8273.3
8350
8450

$1.00 EACH

11 for $10.00, Postpaid

PLEASE ENCLOSE FULL AMOUNT WITH ORDER
QUANTITIES AVAILABLE
WRITE FOR YOUR REQUIREMENTS

C & H SALES CO.

BOX 356-MT EAST PASADENA STA. • PASADENA 8, CALIF.

Commission. Revenues of the AM-FM broadcast industry in '52 amounted to $473.1 million or about 5 per-cent above '51. While seven networks (four nationwide and three regional, and including 25 owned and operated stations) estimated total revenues of $101 million, or 3 per-cent below '51, more than 2300 other radio stations estimated total revenues of $372.1 million, an increase of 7.4 per-cent above '51.

In the 63 TV markets (*i.e.*, those with operating TV stations prior to '52), 108 TV stations reported as much total revenue from TV operations as did 529 AM licensees from AM station operation. More than three out of every five broadcast advertising dollars spent in Los Angeles, Columbus, and Cleveland were spent on TV in those markets.

The total revenues from the TV industry were estimated at $336.3 million for '52; approximately 43 percent above the '51 volume of $235.7 million.

Networks (including their 15 owned and operated stations) reported revenues of $191.9 million, expenses of $182.9 million and income of $9 million. The '52 network TV revenues were almost 50 per-cent above '51. However, as a result of a proportionately greater increase in expenses (56 per-cent) network income was reported at $2 million below the '51 figure of $11 million.

Ninety-three TV stations (excluding 15 network owned and operated stations) estimated total revenues of $143.7 million or about 33 per-cent above '51. With station expenses increasing at a slower rate (28 percent) the income of these stations rose to $45.6 million or 51 per-cent above '51. Fourteen stations, authorized in '52 since the freeze lift, estimated total revenues of $700,000, expenses of $800,000 and a loss of $100,000. Of the 14 stations, only three were in operation more than two months during '52.

ALTHOUGH hampered by a lack of hearing examiners, many approvals for new construction appeared on the late Spring docket. At this writing, post-thaw authorizations have risen to nearly 360, with a majority of the grants made to the high-band stations.

Once again, as the table on page 75 illustrates, many new areas appear on the new-station timetable. Among these newcomers are Miami, Oklahoma, and Keene, New Hampshire.

IN REPORTING on the communication facilities designed for the Olympic Games of '52 at Helsinki, a few months ago, it was noted that about 150 commentators from about 30 countries were expected to attend, and accordingly an extensive array of mikes, amplifiers and associated gear would be required. It has now been learned that 41 countries were represented with 147 commentators, together with 21 observers and technicians. To meet the demands of these announcers and associates, 34 microphone positions had to be set up, each position providing facilities for a commentator, assistant, and an interpreter. To assure constant uninterrupted contact, a set of round-the-clock circuits were placed in operation; Helsinki was permanently connected during the sixteen-day period of the games over eleven trunk circuits to Stockholm, Oslo, Copenhagen, Berlin (2 circuits), Hamburg, Stuttgart, Cologne, Brussels, London, and Hilversum. Scandinavian broadcasting stations handled most of the long-distance s.w. transmissions. . . . . L.W.

Where do you want to go in TV-ELECTRONICS and how soon will you get there?

Free CREI booklet lists opportunities and gives you a plan for grasping them!

o YOU HAVE a career time-table? Do you know how much you should or could be earning two years from ? Five years? Many men are plodders without a . They wander through life never doing what they t to do, never receiving enough pay, never achieving career satisfaction. Because they never knew ahead ime where they should or could be at a given date, never planned ahead. When an opening arises, some-y else is promoted. When January 1st rolls around, 're just where they were a year before. Their *error*, are to plan, can be the lesson which shows you the *et* of future success. In this expanding, bustling TV-tronics world, there is a whole lifetime of happiness high earnings waiting for you, if you name your s, and take steps to reach them. Thousands of ambi-s young men have found success in TV-Electronics ugh the aid of the CREI booklet, "Your Future in the World of Electronics." The newest edition tells of tronics' golden opportunities. Almost 200 TV stations now on the air. 2,000 more are on the way. There are 21,000,000 TV sets and over 100 million radios in use.

is the era of Communication: aeronautical, marine, ce and fire, industrial, land transportation communi-ons; this is the era of defense orders and a manufac-ng industry which last year alone sold billions of dol-worth of electronic equipment, and is expected to do less than 10 billion dollars worth excluding military ers. All these developments mean positions; in devel-ent, research, design, production, testing, inspection, ufacture, broadcasting, telecasting and servicing. Who get these positions? You—if you have a career time-e; if you can foresee your future in electronics; if are willing to advance your knowledge; if you spend nutes to write for your copy of "Your Future In the New ld of Electronics," and follow the plan it describes.

is the booklet that shows you how CREI home study s the way to greater earnings. However, being an ac-ited technical school, CREI promises you no short-. You must translate your willingness to learn into ble technical knowledge via study. CREI knows what neans to grow along with a booming industry. This CREI is celebrating its 26th Anniversary, having ted in 1927 in the early days of radio. Since then I has provided thousands of professional radiomen technical educations. During World War II, CREI ned thousands for the Armed Services. Leading firms CREI courses for group training in electronics at com-expense; among them are United Air Lines, Canadian Broadcasting Corporation, Trans-Canada Airlines, Sears Roebuck & Co., Bendix Products Division, All-American Cables and Radio, Inc., RCA-Victor Division and Machlett Laboratories. CREI courses, prepared by recognized experts, are constantly revised to keep them up-to-date. Student work is under the personal supervision of a CREI Staff Instructor who knows and teaches what industry needs.

You choose your own hours when you study at home. Upon completion you join the many CREI graduates who have found their diplomas keys-to-success in Radio, TV and Electronics. CREI alumni hold many top positions in America's leading firms.

At your service is the CREI Placement Bureau which helps find positions for students and graduates. Although CREI does not guarantee jobs, the bureau now has many more requests for personnel than can be filled. Talk to men in the field and check up on CREI's high standing in electronics instruction. Determine for yourself right now that your earnings are going to rise with your knowledge — and that you will rise with this booming industry. All this CREI offers you, provided you sincerely want to learn. Fill out the coupon and mail it today. We'll promptly send you your free copy of "Your Future in the New World of Electronics." The rest—your future—is up to you.

CREI resident instruction (day or night) is offered in Washington, D. C. New classes start once a month. VETERANS: If you were discharged after June 27, 1950—check the coupon for full information about the new G.I. Bill of Rights.

MAIL COUPON FOR FREE BOOKLET

CAPITOL RADIO ENGINEERING INSTITUTE
Dept. 117 3224 16th St., N.W., Washington 10, D. C.
Send booklet "Your Future in the New World of Electronics" and course outline.

CHECK FIELD OF GREATEST INTEREST
- ☐ TV, FM & Advanced AM Servicing
- ☐ Practical Television Engineering
- ☐ Broadcast Radio Engineering (AM, FM, TV)
- ☐ Practical Radio Engineering
- ☐ Aeronautical Radio Engineering

Name ....
Street ....
City.............. .... Zone...... State..................
Check ☐ Residence School ☐ Veteran

SENSITROL RELAY

WESTON SENSITROL, coil sensitivity only 10 microamps! Built like meter. At 10ua, needle swings over into permanent magne. which grips it to close contacts rated 1 ampere. Perfectly damped: vibration will not close contacts. Built-in reset relay unlatches contacts when 12 to 24 volts AC or DC is momentarily applied to reset leads. The Sensitrol works directly from photocells, thermocouples, or any source of minute current. No electronic amplifier needed! A $69.50 precision device for only........ $12.95

SENSITIVE POLARIZED RELAY

This is the device that the services use to replace selsyns. Now offered to the public for the first time! SP/DT, both contacts normally open. The POLARITY of an applied 1/2 VDC, 5 MA current determines which contact closes. Use for micro-positioning, remote control, model control, etc. Our free data sheet shows you just how to use it. In metal box with two other heavier duty relays. NEW, slightly dirty. $6.95
(Shipping weight, 4 lbs.)

SUPER SENSITIVE RELAY BK-7-B

Single pole, double throw. Coil 4000 ohms. Sensitivity accurately adjustable on calibrated scale. At 5 on scale sensitivity is 1/2 milliamp (1 milliwatt, 2 volts) and from 5 to 40 on scale the sensitivity decreases linearly to 1.5 ma (9 milliwatts, 6 volts). Thousands of uses: telemetering, voice-operated or capacity operated or thermocouple operated circuits, sequence circuits, etc. Fully encased, 1 1/2"x3 3/8"x 1 1/4" deep. Weight, 6 oz. With hinged contact-inspection door and screwdriver adjustable stationary contacts....Brand New, Only **$1.95** each, 10 for **$17.50**
(Shipping Weight, each, 1 lb.)

A SENSITIVE RELAY!

Closes at 4 to 5 ma. (Extra set of SP/ST contacts for additional sequence, close at 6.5 ma.) Coil 6000 ohms. Sensitivity easily altered by bending limit arm or changing spring. Only 1 1/2" x 2 1/8" x 1 5/8" overall. Dozens of applications, and offered **at a "stock up"** price. Removed from clean equipment.
ONLY 98c each, 3 for $2.75
Boxed, reconditioned, like new..............**$1.69**

PRECISION CALIBRATING CRYSTAL

200 KC. Same as used in late model Collins Autotune Xmtrs. In FT-241-A holder (1/2" pin spacing). Use in Pierce untuned oscillator circuits to get check points very close together all the way up the spectrum. **BRAND NEW** **$2.95**

12 CHANNEL T-V TUNER

Complete front end, famous make "Silver Circle." Furnished with original factory instructions, less tubes. Dozens of uses; receivers, converters, etc. The TV bargain of the year for builders, amateurs, students. These are factory rejected for minor damage..........**ONLY $1.95 each, 3 for** $5.00
(Shipping Weight, each, 3 lbs.)

OIL FILLED FILTER CONDENSERS
(All famous makes)

10 mfd, 600 vdc; 3"x1 3/4"x5 5/8" OA ht., **BRAND NEW $2.75**
6-6 mfd, 600 vdc, 2 1/2"x2 1/2"x4 1/4" high, bolt mounting, lugs under........**BRAND NEW 2.85**
8-8 mfd, 600 vdc, 2 1/4"x2 1/2"x4" high, bolt mounting, lugs under........**BRAND NEW 2.95**

2" PM SPEAKERS, heavy magnets. ....**BRAND NEW $1.25**

12 VOLT RECEIVER DYNAMOTORS. Deliver 250 vdc, 60 ma. Shipping wt. 4 lbs. **EXCELLENT USED $7.95**

274N PLUG. 7-prong male plug to fit back of command rcvrs, and xmtrs. This is the same plug as used in the racks. NEW, each **21c**: five for..............**$1.00**
Local Control Adapter Parts for 274N or ARC-5 rcvr. Exact pot, switch, knobs, etched plate, and instruction data. Ready to mount....................**$1.29**
SPLINE TUNING KNOB............................**79c**

0-1 DC MILLIAMMETER

A hard-to-get meter at a hard-to-beat price. These are unused 2 1/4" aviation type meters which we have modified for general use, including new white scale plate with large, easy to read calibration. **ONLY** $4.50

PE-101-C DYNAMOTOR. Brand new. (Shipping weight, 13 lbs.)................$4.95

OUTPUT TRANSFORMER. 5000 ohms input to TWO outputs, 300 ohms or 3.5 ohms. Use as output for 12A6, 6V6, etc., or to match speaker or headset. **NEW, potted, shielded**.......................**79c**

ANTENNA MAST SECTIONS, MS-49, 50, 51, 52, New, original packing.................Each 39c

CRYSTAL MICROPHONE GIVEAWAY!

Sensitive hearing aid capsule sealed in neat, compact, flat container with tinned terminals. Crisp, clear, high-level output. Ideal for lapels, ties, tuck-aways. Individually tested and guaranteed. **ONLY** 98c

CERAMIC COIL FORM ASSORTMENT

Contains 12 BRAND NEW ceramic coil forms, various diameters and spacings..........**ONLY** 98c
(Shipping wt.—10 lbs.)

BROADCAST BAND & AERO

MN-26-C Remote Controlled navigational direction finder and communications receiver. Manual DF in any one of three freq. bands, 150 to 1500 KC. 24 V. Self-contained dynamotor supply. Complete installation, including receiver, control box, loop, azimuth control, Left-Right Indicator, plugs, loop transmission line, and flex. shafts. BRAND NEW, ORIG. PACK...... $69.50
(Shipping Wt. 75 lbs. Express Collect.)

HI-FI HEADSET

Uses annular grooved plastic fibre cones with voice coils as in speakers, and padded chamois ear muffs to obtain spacing for correct acoustical load. Gives finest music reproduction, flat far beyond upper and lower limits of auditory perception. Pair in series has measured impedance of 600 ohms at 1000 cycles, obtained with built-in high quality transformers. Checked out with freshly laundered ear pads...**$7.95**
(Shipping weight, 3 lbs.)

6 V VIBRATOR KIT. Vibrator plus non-sync transformer, two outputs: 700 VCT. 145 ma for plates; 15 V for bias. Can deliver 320 V at 130 ma. (Shipping wt. 6 lbs.)..............**NEW** $2.89

EASY MONEY!

We're still buying surplus gear. Tell us what you've got, its condition, and your price. If we like it you'll get our check quick.

G. L. ELECTRONICS

905 S. Vermont Ave., Los Angeles 6, Calif.
All Prices F.O.B. Los Angeles Calif. Buyers Add Sales Tax
GET ON OUR MAILING LIST

MANUFACTURERS' LITERATURE

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

FREE REPRINT

The Mellon Institute, 4400 Fifth Avenue, Pittsburgh 13, Pa. is making available without charge copies of an article "Electronics in Industrial Research" by Axel H. Peterson.

This article by Dr. Peterson, who is head of the department of instrumentation at the Institute, originally appeared in the magazine *"Industrial Laboratories."*

NEW "VARIACS"

General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass. has recently issued a 12-page catalogue describing its "V-line Variac" autotransformers.

These new units incorporate the "Duratrak" construction, a silver alloy coating applied to the brush tracks to prevent contact surface deterioration even when operating at fixed brush settings.

The catalogue explains the operation of these new autotransformers and describes the various units currently available.

"SHORT-FORM CATALOGUE"

Tektronix, Inc., P. O. Box 831, Portland 7, Oregon has issued a "Short-Form Catalogue" which pictures and briefly describes its line of test instruments for laboratory and service work.

Included are seven oscilloscopes, two square-wave generators, one amplifier, two preamplifiers, one time-mark generator, and a series-waveform generator.

A listing of the company's representatives and branch offices is also included.

COMPONENT DEVELOPMENTS

Aerovox Corporation of New Bedford, Mass. is currently offering a new bulletin which deals with recent electronic component developments, particularly high-temperature metallized-paper condensers and other of the company's products.

The Advertising Department of the company will forward a copy of this 6-page bulletin which also describes resistors, high-voltage plate assemblies and ceramic condensers as well as the company's printed-wiring development.

NEW AMPLIFIER DATA

A new revised edition of the company's "Williamson Amplifier" instruction sheet has been issued by *Standard Transformer Corporation* of 3580 Elston Ave., Chicago 18, Ill.

Complete with performance curves, schematic, parts list, chassis layou and diagrams, the sheet has been revised and reissued in response to heavy demand for this material.

Three *Stancor* transformers ar used in the circuit and two complete punched and finished chassis ar available from distributors to mak construction of the amplifier as eas as possible.

SPRAGUE CATALOGUE

Sprague Products Co., 51 Marsha St., North Adams, Mass. has issued comprehensive catalogue describin and listing its ceramic condensers.

Covering more than 375 ratings i 11 different voltages from 300 t 20,000 volts d.c., ranging in size an style from the company's subminiature units to its molded plastic co densers, the listing includes all c *Sprague's* greatly enlarged ceram line.

Designated as Catalogue C-650, th listing includes all the ceramic condensers a service technician migh possibly need. Copies of this publ cation are available from all of th company's distributors or from th company direct.

RECTIFIER DATA

The *Electronic Rectifier Co.* c Rochester, N. Y. is issuing a one-pag catalogue sheet which lists and describes twelve of the company's 1 products.

By using an almost telegraph style of copy, these twelve items ar described in sufficient detail to giv a prospective buyer a good idea o the type of rectifiers and batte chargers available.

IRC DIODE DATA

International Rectifier Corporatio 1521 E. Grand Ave., El Segundo, Cal fornia has issued a bulletin, GD- which describes in detail the chara teristics and advantages of its ne line of germanium diodes.

The company is now in a positi to produce germanium diodes in an quantities desired. Any of the stan ard units listed in the bulletin ma be shipped from stock. Larger pr duction quantities can be scheduled meet requirements.

ATTENUATION FILTERS

Cornell-Dubilier Electric Cor South Plainfield, N. J. has issued 12-page catalogue with descriptio illustrations, and technical data a portion of their wide line "Quietone" filters.

ore than 135 different types of the pany's feedthrough, pi, and uni- al filters are listed in the new etin. It includes filters for r.f. ntuation in virtually every type ectronic and electrical equipment. esides complete, detailed, electri- characteristics, the descriptions ude outline drawings, physical racteristics, circuit diagrams, ographs, and charts.

copy of Bulletin No. NB-148 is lable from your *C-D* distributor actory representative or from the pany direct.

REPLACEMENT PARTS

erit Coil and Transformer Corp. hicago has announced the availa- y of a new and revised edition of "TV Repl Guide".

his year's edition, which has been anded to 40 pages, features the tion of helpful i.f.-r.f. coil and h-linearity coil listings. The new 406 also contains information on flybacks, yokes, and power trans- ers manufactured by the com- y.

"GOLD BONDED" DIODES

ransitron Electronic Corp., 403-407 n Street, Melrose 76, Mass. has is- l a 4-page bulletin giving com- e technical specification on its line of "Gold Bonded" diodes.

cluded in the publication is infor- ion on the Types 1N48, 1N51, 8, 1N63, 1N69, 1N70, 1N81, T1, T3, T4, and T5. Performance es and other characteristics are uded along with a large cut-away ving showing the construction of diodes.

copy of Bulletin #TE-1300 is lable on request.

"HUSKY" RELAYS

ice Electric Corporation, Freder- Maryland is currently offering es of a 4-page bulletin describing ine of "Husky" relays.

cluded are photographs and speci- ions on subminiature, balanced ature, high-shock, hermetically- ed, high-current, etc. relays. All e relays described were exhibited he recent IRE show.

pies of this bulletin are available out charge. Please specify "the bulletin" when making your est.

RCA TUBE BOOKLET

e *RCA Victor Division* of *Radio poration of America*, Harrison, N. as issued an up-to-date "Who's " of *RCA* electronic tubes which ribes 495 different receiving types kinescopes having their chief ap- ation in radio and television ivers.

e new booklet, Form No. 1275-F, designed to provide service deal- with an up-to-date catalogue of receiving tube information and rve as a guide in the selection of t suitable tubes for given appli- ons.

copy of *"RCA* Receiving Tubes

A new concept of recorded music

THE HEATHKIT *Dual* RECORD PLAYER KIT

- Dual matched speakers for room filled perimeter sound
- Plays all record sizes, all speeds
- Newly developed ceramic cartridge
- Automatic shut off for changer and amplifier

MODEL RP-1
$59.50
SHIPPING WT. 30 LBS.
Shipped Express Only

Here is a *new* introduction to quality record reproduction. A simple to operate compact table top model with none of the specialized custom installation problems usually associated with high fidelity systems. Two matched speakers mounted in an acoustically correct enclosure reproduce *all* of the music on the record. Reproduction with the unique sensation of being in a halo of glorious sound.

The world famous VM Tri-O-Matic record changer plays all three record sizes at all three speeds. Automatic shut off for both changer and amplifier after the last record is played. A wide range ceramic cartridge features an ingenious "turn-under" twin sapphire stylus for LP or 78 records without turning the cartridge. Simplified easy to assemble four tube amplifier featuring compensated volume control and separate tone control. Proxylin impregnated fabric covered cabinet supplied completely assembled. You build only the amplifier from simple step-by-step instructions. No specialized tools or knowledge required.

The Heathkit Dual Kit includes cabinet, VM player, speakers, tubes, and all circuit components required for amplifier construction. If a kit project has ever tempted you, here is the perfect introduction to an interesting and exciting pastime. Build the Heathkit Dual and enjoy unusually realistic room filling reproduction of fine recorded music.

OTHER *Famous* HEATHKIT AMPLIFIERS

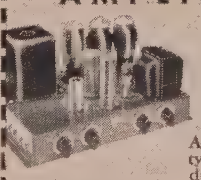
THE HEATHKIT 6 WATT AMPLIFIER KIT

Model A-7B
$14.50
Ship. Wt. 10 lbs.

The Heathkit Model A-7B Amplifier features separate bass and treble tone controls — two compensated inputs — three output impedances 4, 8, and 16 ohms — frequency response ± 1½ db from 20 to 20,000 cycles — push pull beam power output at full 6 watts.

Heathkit Model A-7C with preamplifier stage.................. $16.50

HEATHKIT *High* FIDELITY AMPLIFIER KIT



$35.50
Model A-9A
Ship. Wt. 17 lbs.

A 20 watt high fidelity amplifier especially designed for custom installations. Low hum and noise level 9 pin miniature dual triodes in preamplifier and tone control circuits. Four switch selected inputs. Frequency response ± 1 db 20 to 20,000 cycles. Output impedances of 4, 8, and 16 ohms.

Write For Free CATALOG
New 32 page 1953 Catalog lists all kits, specifications, schematics and latest price information.

HEATH COMPANY
BENTON HARBOR 15
MICHIGAN

YOU SAVE BY ORDERING DIRECT FROM FACTORY

for AM, FM, and Television Broadcast" is available from the company's tube distributors.

TRANSVISION TV KITS

The Educational Dept. of *Transvision, Inc.*, New Rochelle, New York has issued an 8-page catalogue listing the various build-it-yourself television kits now available from the company.

Emphasis has been placed on "packages" than can be assembled by those with no special technical training. The kits are broken down into "stages" which can be built and then assembled into a complete receiver.

A copy of catalogue No. K153 is available from the company on request.

RELAY DATA

Potter & Brumfield of Princeton, Indiana has released its Catalogue #122 describing a line of relays, contactors, and shaded pole motors.

Included are relays and contactors for every electrical and electronic application—power, multiple contact, multiple leaf, latching, plate circuit, impulse, space saver, telephone, miniature, shockproof, etc. Also shown are enclosures for sealing individual relays or multiple groups hermetically, and octal, solder-terminal, and miniature plug-in connections.

Copies of this 24-page catalogue are available without charge.

WIRE CATALOGUE

United States Wire & Cable Corp., Progress & Monroe Streets, Union, N. J. has issued a new catalogue which lists and illustrates wires and cables used in communications, electronics, television, etc.

This 24-page catalogue, No. PM-3, is lithographed in two colors for added legibility and contains many valuable reference tables, diagrams, and charts. Each class of wire or cable is described in detail as to construction, chemical, and physical properties as well as typical uses.

Make your request on your company letterhead for a free copy of this catalogue.

CARTRIDGE REPLACEMENTS

The new *Shure* phonograph cartridge replacement manual, #66, is now available without charge at all *Shure Brothers, Inc.* distributors.

The new publication has been designed to aid service technicians and distributors in selecting the correct cartridge replacement for over 1900 phonographs, radio-phonographs, and radio-TV-phono combinations manufactured from 1938 through 1952.

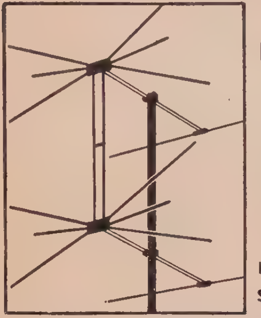
The manual also includes technical data on the company's line of magnetic tape and wire recording heads. This information includes typical operating data, descriptions, and a numerical listing.

REPRINTS AVAILABLE

A novel method of placing and orienting u.h.f. antennas for maximum TV picture signal is described in a

National Electronics GREATEST Special Purchase BARGAIN

Tremendous Savings While They Last



2 BAY 16 ELEMENT CONICAL ARRAY

INCLUDING HIGH BAND ADAPTERS

$4.65 Each IN LOTS OF THREE

Single Lots $4.95

Never before has National Electronics had a BARGAIN like this. We made a special purchase in order to get these sensational prices. And this array has everything. This conical 2-bay 16-element array provides ultra-fine fringe reception. Includes sixteen 1/4-inch airplane type aluminum elements, including hi-band adapters for greater gain on the high channels and is complete with one pair of stacking bars to each array. These are packed in cartons of three 16-element arrays per carton, with tie rods, at **$13.95** per carton.

When purchased in single 16-element arrays, separately boxed—your cost is..$ 4.95 each

3 Two-Bay Arrays per carton without Tie Rods .... 12.50 carton

4 Bay Ultra-Fringe Stacking Assembly for Above—Model 4B........ 1.95 set

SAVE WITH ROCKET 35-FT. MAST KITS

Economy mast kit contains 3—10′ seamless TRI-COATED 1 1/4″ O.D. masts, one 5′ mast, 300 feet of 6/20 galvanized steel guy wire, and everything else needed including guy rings, mast connectors, insulators, cable clamps, guy hooks, and swivel mounting base.

35-foot Mast Kit........ **$15.95** 25-foot Mast Kit........ **$11.95**

LOWEST PRICES ON ANTENNA ACCESSORIES

Mast Steel (Dualcoated 5′ crimped) 1 1/4″ O.D..$1.05
Mast Steel (Dualcoated 10′) 1 1/4″ O.D. 1.95
Mast Connectors for 1 1/4″ O.D. Mast........ .59
Chimney Mount Complete with Straps........ 1.19
Peak Roof Saddle (will take up to 1 1/2″ O.D.).. 1.59
Lightning Arrestor—TV .... .69
Galvanized Steel Guy Wire—6/20........ 3/4c ft.
Rocket Twin-Lead—7/28 stranded........ 2c ft.
UHF Low loss tubular 300 ohm twin lead—100′ coil 4.95
Open Wire for long lead-ins—500′ reel......19.80
Mast Stand-off Insulators—3″........ .10
Screw Type Stand-off Insulators—3″........ .03

ALL PRICES F.O.B. CLEVELAND, OHIO

Do not remit more than complete purchase price. Pay shipping charges on receipt of goods. 25% deposit on all C.O.D. orders, please. Money-back guarantee. Prices Subject to Change Without Notice.

Sensational Reception on ALL UHF AND VHF CHANNELS

Covers channels 2 thru 83. Sensational broad band performance makes it a favorite in many areas where there is more than one transmitter. High gain suitable for fringe usage. Serviceman's array includes eight 3/8″ aluminum elements, two 1/2″ Aluminum Cross Arms, Universal Mast Clamp.

Model AR-58 ....$6.95 Ea.
Lots of 6 $6.50 Ea.
Matched Stacking Bars. Per pair........ .90 Ea.

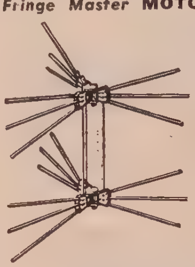
ROCKET BROAD BAND YAGIS

- SENSATIONAL GAIN
- SENSATIONAL PICTURES IN FRINGE AND ULTRA FRINGE AREAS

Switch to Yagi Broad Band Hi-Gain Antennas! These new Yagis give you Yagi reception on the 5 low-band and 7 hi-band channels—no restriction to one single channel. A two-bay array will out-perform even a 10 or 12-element single channel Yagi. Price is sensationally low. Complete serviceman's array includes 1 double reflector, 2 folded dipoles, 3 directors. Universal mast clamp. Easy-to-assemble quick rig construction.

Model RB26 Ch. 2 thru 6........$10.95 Ea.
Model RB713 Ch. 7 thru 13........ 5.95 Ea.
Matched stacking bars .... 1.25 Pr.

***Fringe Master* MOTORLESS DIRECTRONIC**



Clear Sharp Pictures — All Channels in All Directions.

- NO GHOSTS
- NO INTERFERENCE
- ELECTRONICALLY BEAMED
- NO MOTORS NEEDED

With new transmitters coming on the air, only the Motorless Directronic offers "round the compass" reception without motors. The Model AX-599 18-element stacked array provides sparkling reception in city or fringe—in all directions. Serviceman's kit provides 18-hi-tensil aluminum elements, 6-position Directronic Beam Selector, 1 set matched stacking bars, 75′ TRI-X Cable, Universal U-Clamp.

Complete Kit $16.95

HI-GAIN SINGLE CHANNEL YAGIS

5 element—Ch. 2, 3, 4...$7.95 Ch. 5 or 6...$6.95
Ch. 7-13...$3.95

CATALOG AVAILABLE

National Electronics OF CLEVELAND

THE HOUSE OF TV VALUES

107 Delco Building Cleveland 3, Ohio

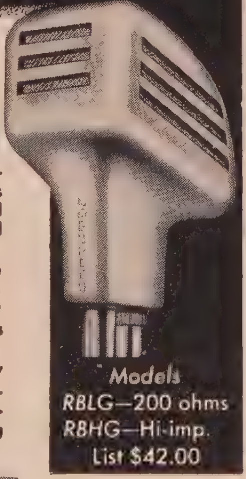
AMPERITE

Studio Microphones at P.A. Prices

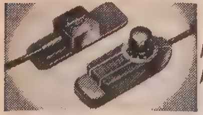
Ideal for BROADCASTING RECORDING PUBLIC ADDRESS

"The ultimate in microphone quality," says Evan Rushing, sound engineer of the Hotel New Yorker.

- *Shout right into the new Amperite Microphone—or stand 2 feet away—reproduction is always perfect.*
- *Not affected by any climatic conditions.*
- *Guaranteed to withstand severe "knocking around."*



Models
RBLG—200 ohms
RBHG—Hi-imp.
List $42.00



"Kontak" Mikes
Model SKH, list $12.00
Model KKH, list $18.00

Special Offer: *Write for Special Introductory Offer, and 4-page illustrated folder*

AMPERITE Company, Inc.
561 BROADWAY • NEW YORK 12, N. Y.
Canada: Atlas Radio Corp., Ltd., 560 King St. W., Toronto

ELECTRON TUBE TECHNICIANS

We now have several openings for technicians to work in the fabrication and processing of advanced type electron tube research models.

To qualify for one of these openings you should be experienced in experimental work for research and development in vacuum tubes, which includes the fields of mechanics, electronics, chemistry and high-vacuum techniques.

ADDRESS RESUME OF TRAINING AND EXPERIENCE TO

HUGHES
RESEARCH AND DEVELOPMENT LABORATORIES

Technical Personnel Department

CULVER CITY,
LOS ANGELES COUNTY,
CALIFORNIA

UBES & PARTS

ALL TUBES are guaranteed for one year . . . individually boxed. Very BEST BRANDS available for immediate delivery!

	59c
	79
	69
	79
	95
	29
	59
	9c
	1.19
	1.19
	69
	.19
	1.19
	1.19
	1.19
	9c
	.99
	9c
	59
	.88
	89
2A6	89c
2A7	
2B3	89
2B7	89
2C34	60
2E5	89
2X2 879	74
3LP4	1.25
3Q4	69
3Q5GT	89
3S4	69
3V4	95
5T4	1.40
5U4G	.59
5V4G	87
5W4	59c
5W4GT	
5Y3GT	45
5Y4G	54
5X4G	81c
5Z3	
6A3	1.68
6A7	[illegible]
6A8GT	69c
6AB4	
6AB7	1.15
6AC5GT	89
6AC7	1.45
6AG5	1.05
6AG7	1.49
6AH6	1.89
6AK5	89
6AK6	1.08
6AL5	69c
6AQ5	
6AQ6	81
6AQ7	1.19
6AR5	.79
6AT6	59
6AS5	90
6AU5GT	1.29
6AU6	59
6AV5GT	89
6AV6	.59
6AX4	69
6AX5	79
6AX6	69
6AY5GT	89
6B4G	1.44
6B8GT	1.15
6BA6	59
6BA7	.89
6BC5	69
6BC7	1.05
6BD5GT	89
6BE6	59
6BF5	69c
6BF6	
6BG6	1.89
6BG6G	
6BH6	69c
6BJ6	
6BK7	1.19
6BL7	79
6BN6	1.19
6BQ6G	1.19
6BQ6GT	1.19
6BQ7	1.29
6BZ7	
6C4	59
6C5GT	69c
6C6	
6CB6	
6CD6	2.49
6CD6G	1.69
6D6 78	1.10
6D8G	1.15
6E5	69
6F5GT	59c
6F6GT	
6F7	1.59
6F8G	1.59
6G6G	95
6H6GT	.89
6J5GT	59
6J6	79
6J7G	69
6J8G	1.15
6K5GT	69
6K6GT	59
6K7GT	69
6K8GT	1.19
6L5G	55
6L6G	95c
6L6GA	
6L7	1.19
6N6G	1.40
6N7GT	2.19
6P5GT	69
6Q7GT	59
6R7GT	69
6S4	59
6S7GT	1.15
6S8GT	1.25
6SA7GT	69c
6SC7	
6SD7GT	99
6SF5	59
6SF5GT	59
6SG7	69c
6SH7	
6SH7GT	.69
6SJ7	79
6SJ7GT	59c
6SK7GT	
6SL7GT	69
6SN7GT	69
6SQ7	59
6SQ7GT	59
6SR7GT	59
6SS7	.89
6T7G	1.15
6T8	89
6U5	69c
6U6GT	
6U7G	
6U8	89
6V3	1.29
6V6GT	69
6W4GT	59
6W6	69
6X4	59c
6X5GT	
6Y6G	.69
6Z4 84	72
7A4	95
7A5	1.19
7A6	89
7A7	79c
7A8	
7B4	.89
7B5	.89
7B6	79
7B7	89c
7B8	
7C4	1.30
7C5	89
7C6	79c
7C7	
7E5	
7E6	79c
7E7	
7F7	89
7F8	1.47
7G7	1.19
7H7	1.05
7J7	1.19
7K7	
7L7	79
7N7	69
7Q7	79
7R7	1.19
7S7	1.19
7V7	.79
7W7	1.19
7X6	1.05
7X7	79c
7Y4	
7Z4	89
12A7	1.59
12A8	.69
12AH7	1.38
12AL5	.54
12AT6	.59
12AT7	89
12AU6	69
12AU7	79
12AV6	59
12AV7	.89
12AW6	1.19
12AX4	.69
12AX7	69
12A7Y	1.95
12BA6	59
12BA7	1.19
12BE6	69c
12BF6	
12BH7	.89
12BY7	.89
12BZ7	1.19
12F5GT	65
12H6	89
12J5GT	.75
12K7GT	.69
12K8	89
12Q7GT	89
12SA7	89
12SA7GT	69
12SC7	1.05
12SF5GT	.69
12SF7	.99
12SG7	.89
12SH7GT	69
12SJ7GT	
12SK7GT	
12SL7GT	
12SN7GT	99
12SQ7	69c
12SQ7GT	
12SR7GT	
12Z3	.95
14A7	1.05
14AF7	93
14B6	89c
14B8	
14C5	1.25
14C7	1.12
14F7	1.05
14F8	1.45
14H7	1.12
14Q7	1.05
14W7	1.49
14X7	1.19
19BG6	1.89
19BG6G	
19T8	89
20	1.40
24A	69
25AC5GT	1.04
25BQ6	1.19
25BQ6GT	
25L6GT	.59
25W4GT	.69
25Z5	.69
25Z6GT	69
32L7GT	1.15
26	59c
27	
35A5	99
35B5	69c
35C5	
35L6	
35W4	59
35Y4	99c
35Z3	
35Z4	75
35Z5	.55
35 51	79
36	1.06
37	93
38	88c
39/44	
41	.72
42	69
43	72c
45	
45Z5	69
46	89c
47	
50A5	1.05
50B5	69c
50C5	
50C6G	1.39
50L6	69
50X6	69
50Y6	99
57	79c
58	
70L7	1.49
70L7GT	
71A	87
75	79
77	69
78 6D6	1.10
80	.69
83	1.45
84 6Z4	72
85	79
VR90	$1.19
VR105	
VR150	
VT51	29c
VT52	
117L7	1.40
117N7	1.95
117P7	1.95
117Z3	.59
117Z6	1.19
715B	7.75
807	1.55
866A	1.49
1294	29c
1299	
1619	
1629	
2050	2.00
2051	1.15

FREE

5 SMALL SCREWDRIVERS with rotating handle and handy case with purchase of $20.00 or more — or 5 lbs. of good usable radio service parts with order of 100 tubes or more—or a kit of assorted radio repair hardware free with purchase of 50 tubes or more.

TELEVISION PICTURE TUBES

D US YOUR
ER AND WE
VILL SHIP
OM STOCK
MEDIATELY

SIZE	PRICE	SIZE	PRICE
7 inch	$17.95	16 inch	$18.95
8 inch	31.50	17 inch	20.95
10 inch	12.95	19 inch	23.95
12 inch	16.95	20 inch	24.95
14 inch	17.95	21 inch	26.95
15 inch	18.95	24 inch	54.95
		27 inch	69.95

AL TUBES $1.50 extra per tube
trostatic Tubes $1.50 extra per tube

ONE FULL YEAR WARRANTY ON ALL TYPES

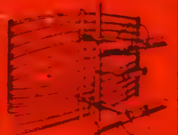
WE PAY FOR YOUR DUD

Your worn out picture tube is worth money if it is not broken.

Size	We Pay	Size	We Pay	Size	We Pay
7"	$1.00	14"	$3.00	19"	$4.00
8"	1.00	15"	4.00	[illegible]	[illegible]
10"	2.00	16"	3.00	[illegible]	[illegible]
12"	3.00	17"	3.00	[illegible]	10.00

These allowances apply when you purchase the same size picture tube.

DAR
PE TV
TENNA



For UHF and VHF
Receives All 82 Channels
WE FINALLY DID IT

ered so many thousands of these ra e TV Antennas, that the cost has own through the savings of mass ion.

ARE PASSING THESE SAVINGS ON TO YOU!

y TV antenna with the money-back ee with the new Electronic Dipole ors. Unbeatable for fringe area and is low, low price we cannot mention turer's name.

st $18.75

MINUM MAST heavy gauge 1½" ith interlocking end. Slip two sec- gether for a ten-footer. $1.00

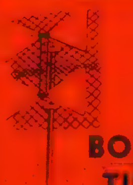
TV Antennas

10 Element conical . . . rugged throughout. Only $3.95

Double bay array, with stacking bars . . $7.75

4 Bay array, with harness and stacking bars $14.95

6 Element Conical. Only . . . $2.95



BOW TIE REFLECTOR

UHF Antenna
Bowtie Reflector
Ultra-high Gain

Completely assembled—ready to mount. For all UHF Channels — easy to stack for two or four-bay.

Single Bay . $4.50
Two Bay, complete . $8.45
Four Bay complete $15.95

VTVM PRECISE

Vacuum Tube Volt-Meter, 1% accuracy ceramic precision resistors; Coax DC connector; FM zero alignment scale: burn-out proof circuit, rugged oversize 4½" meter. Model 909, factory wired $44.98. 909K—Kit. Only $25.98

Model 300
Precise
Oscilloscope
Here Is the Buy

7" tube size, Sweep magnifier, complete push-pull from input through output. Vertical sensitivity better than 10 millivolts. Bandpass 0 3db, 0 to FIVE mc. complete with phasing control, blanking control, intensity mod. and self-measurement peak to peak feature, with DC amplifiers throughout as found only in scopes selling for over $950.00. Exclusive, easy maintenance feature.

In kit form ONLY $94.95

[illegible]

12" COAXIAL PM SPEAKERS High Fidelity with high pass filter attached. [illegible] 17500 cps. response. 8 ohm Voice Coil ea. [illegible]

8" COAXIAL PM SPEAKERS ea. $9.95

Very best quality NATIONAL BRANDS Individually Packed

3"	ea.	$1.39	8"	ea.	$3.23
4"	ea.	1.59	10"	ea.	5.10
5"	ea.	1.59	12"	ea.	5.95
6" SPECIAL PRICE				ea.	1.79

TV CONVERSION KITS

Consisting of rectangular tube, 70 DEGREE YOKE, Beautiful Mask and FLY BACK TRANSFORMER.

21" TV Conversion Kit, as above, complete.	$31.95
20" TV Conversion Kit, as above, complete.	28.95
17" TV Conversion Kit, as above, complete.	23.95
24" TV Conversion Kit, as above, complete.	69.95
27" Conversion Kit, as above, complete.	89.95

MISCELLANEOUS BUYS

I. F. TRANSFORMER 456 kc	[illegible]
PILOT LIGHTS, Type No. 47 10 for 39c, 100 for	$2.9[illegible]
VOLUME CONTROLS [illegible] 2 shaft, 1 meg, ½ meg, ¼ meg	[illegible]
SINGLE ION TRAPS ea.	[illegible]
OUTPUT TRANSFORMER—for 50L6 for 6V6	[illegible]
UNIVERSAL OUTPUT TRANSFORMER	99c
CHIMNEY MOUNT for TV ant.	$1.39
6-foot LINE CORD UL 10 for	$1.95
TV INTERLOCK CORDS ea.	49c

TUBE KITS

BEST BRANDS AT BEST PRICES

3V4, 1T4, 1R5, 1S5	$2.19
3Q4, 1T4, 1R5, 1S5 List Value $8.00 Tube Kit only	$1.98
3S4, 1T4, 1S5, 1R5 List Value $7.80 4-Tube Kit	$1.98
1U4, 3S4, 1S5, 1R5. List Value $7.80. All Four Tubes for	$1.98
117Z3, 1U5, 3S4, 1R5, 1T4. AC-DC Portable Kit. All for	$2.49
12AT6, 12BA6, 12BE6, 35W4 50B5. 5 Tubes for. .	$2.59
35Z5GT, 12SQ7GT, 12SK7G. 5 Tubes for	$3.22

REGENCY UHF CONVERTER

UNIVERSAL-CONVERTERS ALL SETS—the only converter recommended for the 5,000,000 split sound and video TV sets now in use as well as all intercarrier TV sets. NET $37.46

RESISTOR KITS

Insulated ½, 1 and 2-watt assortment of most used values. I.R.C. Ohmite, Stackpole, Speer, etc. 100 for $2.95

300 OHM TWIN LEAD

55 Mil, 100 ft.	$ 1.59
1,000 ft.	13.95
20 Ga. 80 Mil, 100 ft. .	1.89
1,000 ft.	16.95
UHF TUBULAR 300 OHM LINE 1,000 ft.	$34.50
100 ft	$4.95

UHF WAVE TRAP

Teleron printed circuit, for channels 14-83 in UHF waveband, clearest picture—20 seconds to attach.

net ea. $2.32

Teleron TV Wave Trap

For VHF Channels 2 through 13. Clears VHF picture, stops interference at once. 30 seconds to attach. ea. net $1.75

"SERVICE SHORT-CUTS"

Careful checking of all the operating controls of a television receiver is an important servicing step. Consider, for example, a set which exhibits poor vertical hold-in but apparently stable horizontal lock-in. Does this mean a defective vertical system? Maybe not. Check the horizontal hold control first. A limited or critical hold-in range would indicate trouble in some stage prior to either sweep system. But a normally operating control would pin-point the trouble in or near the vertical system. Whenever something happens to disturb both sweep systems, the vertical usually reacts first because it is not protected by an a.f.c. circuit.

MS: 20% DEPOSIT with order, balance C.O.D. ALL shipments F.O.B. Chicago. ORDERS LESS THAN $5.00—$1.00 SERVICE CHARGE. CABLE ADDRESS: CONTULAB. These prices supersede all previously advertised prices, subject to change without notice.

EMIER RADIO-TV SUPPLY, division of CONTINENTAL CORPORATION

AEROVOX
ASTATIC
BURGESS BATTERY
CLAROSTAT MFG.
CRAFTSMAN
DU MONT LABS.
FEDERAL TEL. & RADIO
GENERAL CEMENT
GENERAL ELECTRIC
HALLICRAFTERS
JFD MFG.
MERIT COIL & TRANSF.
QUAM-NICHOLS
REGENCY
HOWARD W. SAMS
SHURE BROS.
SIMPSON ELEC.
V-M

New Portable Battery-Operated Spring-Motor Tape Recorder

The Magnemite*

For all field recording without AC power! Smaller and lighter than a portable typewriter, the Magnemite* actually makes field recordings that can be played on *any* studio console equipment. Completely self-powered, the Magnemite* does away with bulky and cumbersome generators, storage batteries and rechargers.

Just check these unusual features:

- **Noiseless and vibrationless governor-controlled spring-motor assures constant tape speed.**
- **100 operating hours per set of inexpensive flashlight-type dry cell batteries.**
- **Earphone monitoring while recording, and earphone playback for immediate quality check.**
- **Operates in any position, and is unaffected by movement or vibration during operation.**
- **Warning indicator tells when to rewind, and shows when amplifier is on.**
- **Broadcast models weigh 15 pounds. Slow-speed models weigh only 10 pounds.**
- **Requires no more desk space than a letterhead, measuring only 11 x 8½ x 5½ inches.**

There's a choice of 5 different models for any recording need. High fidelity units, meeting primary and secondary NARTB standards, which record and play back frequencies up to 15,000 cycles, are available for broadcast stations, critical music lovers, and scientific research. For investigation, missionaries, reporters, and general dictation while traveling, there are units which play up to 2 hours per reel of tape.

AMPLIFIER CORP. of AMERICA
398 Broadway, N. Y. 13, N. Y.

**Trade Mark Reg*

free reprint being offered by *United Technical Laboratories,* Morristown, N. J.

Designated as *UTL* Bulletin #2, the publication is a reprint of John T. Frye's article "The Versatile Crystal Probe" which originally appeared in the April 1951 issue of this magazine.

The article explains how a single service technician can check the entire roof and obtain maximum picture signal strength. The method described recognizes that, at u.h.f., a difference of as little as three feet in antenna placement, and five to ten degrees in orientation, can make a great difference in the strength of the received picture. —30—

The "Q-L-C"

(*Continued from page* 61)

will serve to check the component.

Principle of Operation

The *"Q"* meter basically is a variable frequency oscillator which feeds an r.f. voltage to a parallel resonant circuit consisting of the inductance to be measured and a variable calibrated condenser. A meter circuit is placed across this resonant circuit.

The oscillator is adjusted to the frequency at which the coil is normally used, and a constant current is passed to the parallel resonant circuit. The variable condenser is set to a value which makes the circuit resonant, as indicated by a maximum reading on the meter. To find the *"Q"* of the coil from this resonant circuit, we use the relation that the *"Q"* of a parallel resonant circuit is proportional to the voltage across it at resonance. If the current to the resonant circuit is a constant, the meter, which reads the voltage drop across the resonant circuit, may be calibrated directly in *"Q."*

Reference to the circuit of the *Heath "Q"* meter, Fig. 1, shows that the signal is obtained from the generator section (12AT7) tube, and the resonant circuit comprises the "Resonance" condenser and vernier, the injection padder condenser (5000 μμfd "Special"), and the coil under test (shown dotted).

In application, and when it is desired to indicate resonance, a v.t.v.m. circuit, consisting of the 6AL5 and 12AU7, is connected directly across the terminals of the "Resonance" condenser. The 680-ohm resistor in the cathode circuit of the second half of the 12AT7 feeds some of the output of the generator to the meter to calibrate the latter for the constant current output. Because the injection padder is much larger in capacitance than the "Resonance" condenser, practically all of the voltage across the coil will also appear across the "Resonance" condenser where it is conveniently measured by the v.t.v.m.

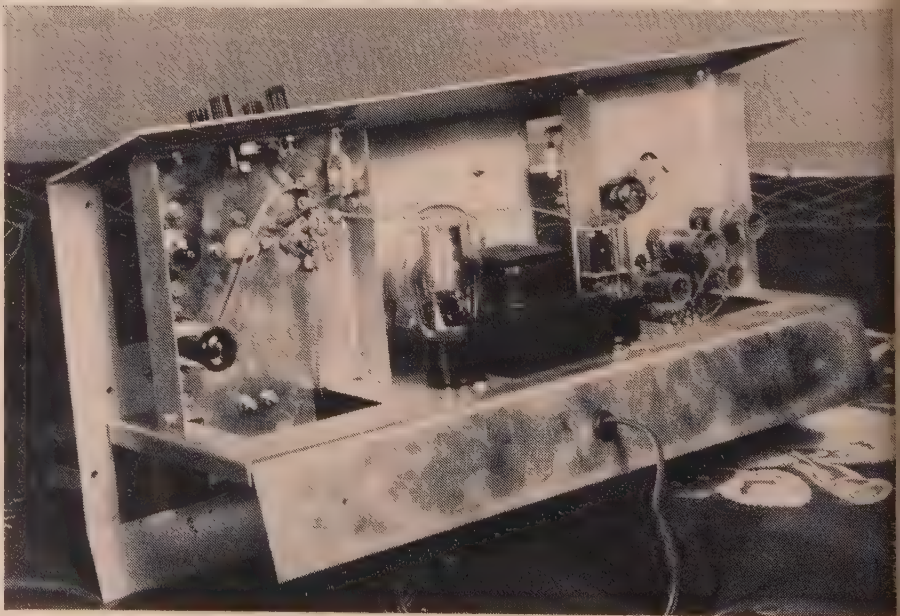
To measure capacitance with the *"Q"* meter, merely insert an inductance across the coil terminals and find the resonance point for the circuit with the unknown condenser — and then without it (at the same frequency). The difference in capacity settings is the value of the unknown condenser.

In order to insure a constant injection current, the output from the generator is fed through a small trimmer condenser in series with the large injection padder. A simple adjustment of the trimmer, during calibration of the instrument, fixes this current accurately.

It is essential that a constant plate voltage be applied to the circuitry. Rectified plate voltage, using a conventional rectifier circuit, is stabilized by a VR-150 voltage-control tube.

The instrument described is one which has gained considerable appeal among aggressive service technicians. It represents, we think, a logical service tool for the radio-television service technician and engineer. —30—

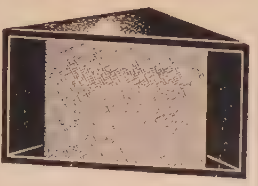
Rear view of the Heath Model QM-1 showing the subchassis construction.



AIL YOUR ORDER TODAY—OLSON WILL RUSH IT RIGHT AWAY!

IE HIGH-FIDELITY AT NEW LOW COST!

volutionary Audio-Tone
h-Fidelity Loudspeaker

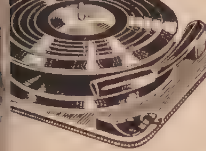


worked shoulder to shoulder with
nic experts to develop the New Au-
ie High-Fidelity Loudspeaker — our
being to give you a powerful yet
t qua'ity speaker system for true
idelity sound reproduction at lowest
e cost. Audio-Tone incorporates the
amous principle of employing the
of a room as an extended bass and
inge reproducer.
on and distortion-free Audio-Tone
akes it possible for you to enjoy the
nal range and fine reception found
the much more expensive space-
ing cabinet loudspeakers. You'll be
by the full, rich, resonant tones
ver knew existed when you attach
dio-Tone to your present AM or FM
Tuners, TV, or Record Player. Special waffle-type Fibro-pad baffle traps
moves all the undesirable tones emitting from the back of the speakers.
Tone's compact size, high power output, tru-tone and attractive en-
also make it an ideal installation for clubs, schools, offices, auditoriums,
s, etc.
assemble, a boy can do it in 20 minutes. Audio-Tone comes complete
" x 9" Low Frequency Reproducer and a 4" High Frequency Reproducer
eter—both with Alnico 5 Magnets, Maroon Leatherette Enclosure, Hand-
lasti-Weve Grille, Hook-up Wire, Cross-over Condenser, Mounting Hard-
nd Full Instructions. Corner Size—18" High, 20" Wide, 10" Deep.
wt. 11 lbs.

Stock No. S-201
Complete, Ready to Assemble....
$19.95

Sets a record! But Gently

3-SPEED GENERAL INSTRUMENT AUTOMATIC RECORD CHANGER WITH GENUINE ASTATIC "TURNOVER" CARTRIDGE



Changes All Sizes—7, 10, 12"
All Speeds—33⅓, 45, 78 RPM

This General Instrument Record Changer has turned out to be Olson's ALL TIME BEST SELLER. For Good Reasons, too! It performs like the Pace-Setter it is—the smoothest running changer on the market today. Records slide gently down the spindle—no chance of damaging those valuable records. Simple to operate—because it is precision-built by craftsmen who have had years of experience, thus insuring years of trouble-free performance.

Changer may be connected to any Radio, TV or Amplifier. Clever "touch-plate" allows you to reject a record at will. Genuine Astatic "Turnover" Cartridge is included at this fabulous low cost. Of course they're Brand New, in original factory-sealed cartons, and guaranteed 100% by Olson and the manufacturer.

Operates on 115 Volts AC, 60 Cycle. Base size 12" x 12½". 5⅛" above plate and 3½" below.

, DELUXE MODEL
ock No. RA-113

d with "Turnover"
e and dual needle.
le for 33⅓ and 45
ises and the other
78 RPM discs. Both
uipped with precious
long-lasting tips.
retail price $52.50.
vt. 15 lbs.

each
ots of
.... **$21.99**

IBE CUSTOM AUTO RADIOS

your chance to save plenty on these nationally
CUSTOM AUTO RADIOS. Simple to install—
es, no brackets, no holes to drill. Install in 3
nutes. Custom-built to fit in dash of each model
ed. Six tubes including rectifier—2 being dual-
—thus you really get 8-tube performance. Dy-
speaker with powerful Alnico 5 permanent
Easy vision slide-rule dial. Beautiful ham-
finish. Shpg. wt. 16 lbs.

$41.97

CHOICE OF ANY MODEL

D.	MAKE OF CAR	YEAR MODEL
	Chevrolet	1949-1950
	Chevrolet	1951-52
	Chevrolet	1953
	Dodge	1949-1950
	Dodge	1951-52
	Dodge	1953
	Ford	1949-1950
	Ford	1951
	Ford	1952

STK. NO.	MAKE OF CAR	YEAR MODEL
RA-144	Ford	1953
RA-451	Hudson	'48-49-50 51-52
RA-751	Henry J.	1951-52
RA-143	Mercury	1952-53
RA-200	Plymouth	1949-1950
RA-651	Plymouth	1951-52
RA-125	Plymouth	1953
RA-551	Studebaker	1950-1951-1952

NEW TOP COWL AUTO ANTENNA "LIGHTS-UP"

Reg. $5.95.
Single, Ea. $1.89
Lots of 12, Each **$1.59**
Stock No. AU-25

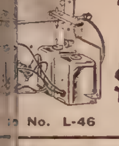
Olson is first with the brightest, niftiest auto antenna ever designed. Dress up your car with this amazing Glo-Tenna that lights up at night. Made of chrome-plated brass, latest glow conductor plastic. Extends to 47½". Top cowl model complete with low loss polyethylene lead-in, bulb and connecting wire and full Instructions. The manufacturer, a leader in auto antennas, requested that we do not mention his name. Shpg. wt. 2 lbs.

Rear Deck Auto Speaker Outfit

Stock No. RA-139. **$6.34**
Complete Kit, only ....

Now you can have a rear deck extension speaker outfit in any car for less than half the regular price. Complete matched set—nothing more to buy. Three-way control switch permits operation of front, rear or both speakers at once. You get: Aluminum neutral finish grille; Heavy-duty 6" x 9" speaker; 3-way switch; All screws, wire and instructions. Shpg. wt. 4 lbs.

PERMEABILITY TUNED AM FRONT END



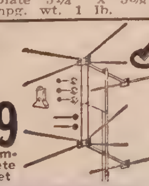
3 for $5.50
$1.89 EACH
No. L-46

BRAND NEW! PARTS ALONE WORTH $4.50. Used in standard broadcast receivers in place of variable condenser and associated parts. Self contained—includes antenna, tuned r-f and oscillator coils, dual trimmers. Designed for linear dial calibration through approximately 340° rotation by means of concentric cam and lever drive. Connects directly to mixer grid and r-f grid to make complete receiver. Mounted on plate 5¼" x 5⅜". Instructions included. Shpg. wt. 1 lb.

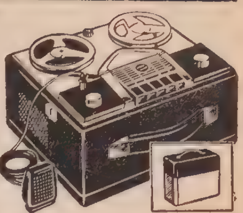
OMPLETE TV ANTENNA

ete stacked array. Made by a
manufacturer whose name and
on every factory sealed carton.
at you get: 2 Six-element coni-
1 pair "Q" bars, 2 Five-foot
tions, 60 ft. 300 ohm twin line,
ff insulators, 1 mounting base,
ng, 1 clamp, hardware. Elements
est quality aluminum. Reg. list
$31.95. Shpg. wt. 15 lbs.
only.

Stock No. AU-24
$12.99 Complete Set



ONLY WILCOX-GAY Recordio TAPE RECORDER with PREST-O-MATIC push-button keyboard gives Maximum performance for Lowest cost!



DUAL SPEED—Records at 1⅞" and 3¾" per second

STOCK NO. AMP-17
$99.50

Records for 2 hours on half of a 7" reel plus another 2 hours on other half at 1⅞" per second: and at the 3¾" per second speed you can record a full hour on each half of a seven-inch reel. 80-6000 CPS.

This is the famous DeLuxe Wilcox-Gay Recorder that retails all over the country for $179.95. Naturally they are all brand new, in factory sealed cartons and Guaranteed 100% by Wilcox-Gay and Olson.

How can we sell this outstanding value for such an amazing low price?

The answer is simple . . . our main purpose in this business is to offer the highest quality for lowest cost . . . and the Recordio is a perfect example.

Record those treasured "Family Highlights" . . . or your favorite music, broadcasts, friends or parties. Use it in your business for dictation, meetings, speeches, etc. Portable Recordio is also a valuable aid in Schools, Churches, and Clubs.

Remember . . . it's completely Automatic . . . the finger-tip controls are so simple even a child can operate it. And we're offering the finest Recorder we've ever featured at LESS than Dealer's Cost.

INSTANTANEOUS RECORDING OR PLAYBACK. 2-SPEEDS, RECORDS, PLAYS BACK, ERASES. LOOK AT THESE QUALITY-PACKED FEATURES: Five "Prest-o-matic" Controls allow instant choice of all operating functions . . . high speed forward and reverse, record, stop, and playback. Handles up to 7" reels. Neon Indicator shows Normal and Overload levels. Full Range Variable Tone Control allows maximum brilliance to a deep, rich bass tone. Volume Control bass and treble compensated for best reproduction. COMPLETE . . . READY TO OPERATE. Included: Weatherproof Controlled Reluctance Microphone. Radio . . . Phono . . . TV Input Jack permits recording from radio, phono or TV speaker voice coil by means of patch cord. External Speaker Jack for external speakers automatically disconnects internal 5" x 7" elliptical P.M. Speaker. 4 Tubes . . . 6SJ7, 6AQ5, 12AX7, 6X4 Rectifier. 7 ft. Cord. Handsome Removable Cover. Operating Instructions. Size: 12" x 14" x 9" . . . 23 lbs. complete. 110-120 Volt 60 Cycle AC. U.L. Approved.

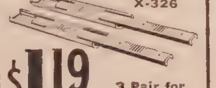
BRAND NEW PLASTIC BASE RECORDING TAPE

600 Ft. REEL	1200 Ft. REEL
STOCK NO. X-275 Single, ea. $1.49 Lots of 10 $1.29 each	STOCK NO. X-249 Single, ea. $2.19 Lots of 10 $1.99 each

Get the buy of your life. Save up to 64% on high quality RECORDING TAPE. A large manufacturer had to sell his inventory and he unloaded the whole deal. Olson now offers you this high grade fully guaranteed recording tape at prices which defy competition. Standard ¼" wide, 600 and 1200 ft. lengths. Frequency response 50 to 8,000 cy. Plastic Reel included with each. Shpg. wt. ea. 1 lb.

PHONO SLIDES

STOCK No. X-326



$1.19 PAIR
3 Pair for $3.00

Used to mount changers in cabinets. Heavy-duty construction. Full ball bearing action. Capacity 50 lbs. 13" long. Reg. List Price $4.00. Shpg. wt. 2 lbs.

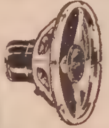
CRYSTAL MIKES

Astatic high output crystal mike for PA systems and recorders. Equipped with handle base and 7' shielded cable. Shpg. wt. 5 lbs.

STOCK NO. M-67, each . . . $5.95

STOCK NO. M-66, same but with on-off switch built into handle **$6.95**

12" CO-AXIAL SPEAKER

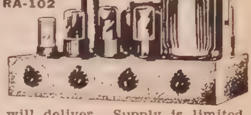


$12.95
Stock No. S-168

Our new 1953 Model. Guaranteed to outperform any speaker in its price class. Equipped with two "high concentration" Alnico 5 magnets and a high frequency diffuser. The 12" section delivers the bass while the inner 3" tweeter speaker section delivers the treble tones. Together they give you "living tone." This speaker is unconditionally guaranteed to satisfy even the most critical user or Olson promises to refund your money. Only two wires to connect to any radio or amplifier. Voice coil impedance 8 ohms. Frequency response 30 to 17, 500 cps. Ship. wt. 10 lbs.

10 WATT HI-FI PUSH-PULL AMPLIFIER

$32.95 WITH TUBES
Stock No. RA-102



- Built-In Pre-Amplifier
- G-E Cartridge Input
- Treble and Bass Boost
- All-Aluminum Chassis
- Push-Pull Output
- Multiple Speaker Impedances

Bombshell Value! It's unbelievable. A full 10 watt Hi-Fi Amplifier, completely assembled and ready to play. Has built-in PRE-AMP for G. E. and similar types of magnetic pickups. 4 Inputs: 1 crystal phono, 1 magnetic phono, 1 radio, 1 mike. 4 Controls: 1 Bass, 1 Treble, 1 Volume, 1 Phono-radio Switch. Output Impedances: 4, 8, 16 ohms. Peak Power output 17 watts.

Order this amplifier today and see what brilliant, realistic tone it will deliver. Supply is limited. Everyone in factory sealed carton. You couldn't buy the parts alone for this price. Remember this is a full size amplifier, transformer operated, not an AC-DC job. Frequency response 30 to 20,000 cps at less than ½ of 1% distortion. 5 Tubes: 1—6SL7, 1—6SC7, 2—6V6, 1—5Y3. Complete with tubes. Size 12" x 6½" x 5½". Shpg. wt. 15 lbs. Can be used with any phono or speaker but you should take advantage of the Combination Deal offered below.

COMBINATION DEAL!

10 WATT HI-FI PUSH-PULL AMPLIFIER COMPLETE WITH 12" CO-AXIAL SPEAKER

Stock No. AS-67
Both for Only $39.95 WITH TUBES
Completely wired. Not a kit.

This is the best matched Amplifier-Speaker Deal in America Today. You get the 10 Watt Hi-Fi Amplifier as described above PLUS the 12" Co-Axial Speaker—also as described above. Can be built into any cabinet or bookcase, giving you a complete amplifier system you will be proud to own and show to your friends. Look at our Amazing Low Price—and Order Today. Shpg. wt. 25 lbs.

PRICES SLASHED TO BITS ON OLSON RESISTOR KITS
GIANT "SUPER-ASSORTMENT" KIT—232 RESISTORS

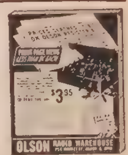
Olson Offers You a Price-Busting Assortment of Brand New, Fully Guaranteed Most-Popular Resistors At the Lowest Price in Our History. Without a doubt this is The Biggest Resistor Bargain to be found in America Today. Every Kit is chuck full of Popular Values—sizes you need and use every day in TV and Radio Servicing. Invaluable to hams and experimenters. Many leading brands of resistors are included such as IRC, Clarostat, Centralab and other top-notchers. KIT CONTAINS: 200—½ Watt Resistors, 20—1 and 2 Watt Resistors, 12—5 to 25 Watt Wirewounds. A total of 232 Assorted Popular Resistors worth at least $23.50. Every Kit is unconditionally guaranteed to please or you get your money back. Every Resistor is RMA Color Coded or stamped with value. Tolerances are 5%, 10% and 20%. This amazing offer will not be repeated when our stock is gone. Shpg. wt. 2 lbs.

$3.95
STOCK No. AS-84

How to Order

Order directly from this ad. State quantity desired, stock number, description and price. You may send remittance with order. (Add for Postage: Estimate at least 5c for each $1.00 of order value,—10c for each $1.00 if you are more than 1,000 miles away. We refund every cent not used) or if you prefer SEND NO MONEY. Olson will ship C.O.D. and you may pay mail or expressman for merchandise and postage

OLSON'S BIG NEW BARGAIN CATALOG FREE!



Get Olson's LOWER-than wholesale prices from this famous book. STANDARD BRANDS—FRESH STOCK. IMMEDIATE DELIVERY. Catalog is two colors—40 full pages of unbelievable bargains. A new catalog mailed Bi-Monthly—with new low bargains each mailing. Simply note on your order or write today for your free copy from: OLSON RADIO WAREHOUSE, 275-C EAST MARKET ST., AKRON 8, OHIO.

OLSON STORES TO SERVE YOU IN:

CLEVELAND, OHIO
2020 Euclid Avenue

★

CHICAGO, ILLINOIS
623 W. Randolph Street

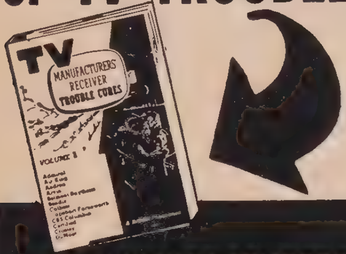
If you live in or near either of these cities visit our Bargain Stores where you'll find these and hundreds of other Olson Buys.

PLEASE: MINIMUM ORDER $3.00

OLSON RADIO WAREHOUSE
275-C EAST MARKET ST., AKRON 8, OHIO

POSITIVE CURES

for TV TROUBLES!



TV MANUFACTURERS' RECEIVER TROUBLE CURES

A brand new series of practical books. Gives you exact directions for correcting TV receiver performance "bugs". Each cure is official, factory-authorized, direct from the receiver's manufacturer. It is positive! Listings by manufacturer and model or chassis number Helps correct the most difficult faults—picture jitter, hum, instability, buzz, tearing, etc.

1 VOLUME 1

Covers 12 prominent brands — ADMIRAL, AIRKING, ANDREA, ARVIN, BELMONT-RAYTHEON, BENDIX, CALBEST, CAPEHART-FARNSWORTH, CBS-COLUMBIA, CERTIFIED, CROSLEY, DUMONT. Over 120 pages (5¼ x 8¼"), illus. **$1.80**

2 VOLUME 2

Covers — EMERSON, FADA, FIRESTONE, FREED, GAMBLE, SKOGMO, GENERAL ELECTRIC, HALLICRAFTERS, HOFFMAN, INDUSTRIAL, INTERNATIONAL, JACKSON. Over 120 pages (5¼ x 8¼"), illus. **$1.80**

3 VOLUME 3

Covers—KAYE-HALBERT, KENT, MAGNAVOX, MAJESTIC, MECK, MERCURY, MIDWEST, MONTGOMERY WARD, MOTOROLA, MUNTZ, NATIONAL, NORTH AMERICAN PHILIPS, OLYMPIC, PACIFIC-MERCURY, PACKARD-BELL, PHILCO. Over 120 pages (5½ x 8½"), illus. **$1.80**

VOLUMES 4 and 5

Coming soon! Covers prominent manufacturers not included in the first three volumes.

One service job will more than pay the cost of this series of books!

NEWEST RIDER BOOKS

HOW TO USE METERS
by J. F. Rider

OBTAINING AND INTERPRETING TEST SCOPE TRACES
by J. F. Rider

Buy these books now at your jobber or book store...or, if not available from these sources:

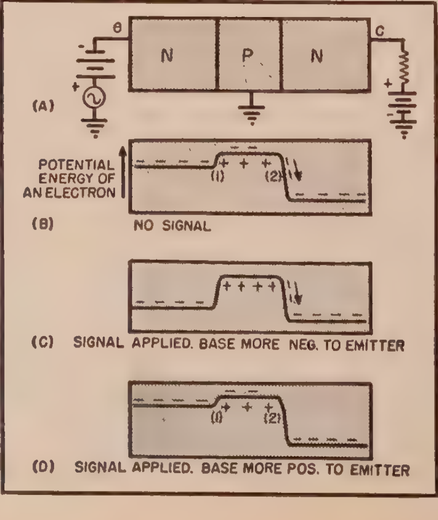
JOHN F. RIDER PUBLISHER INC
Dept. RN7 480 Canal Street, New York 13, N. Y.

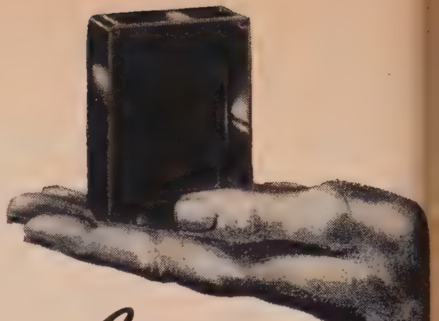
Transistor Physics

(Continued from page 46)

the emitter and the *n*-type on the right is called the collector. The *p*-type at the center is called the base. The connections to the crystals are designated *e, c,* and *b* respectively. Fig. 6B shows a schematic representation of the distribution of donors, acceptors, holes, and electrons, with no external potentials applied (equilibrium conditions). Fig. 6C is the potential energy diagram for holes. As expected, the holes are concentrated in the region of lowest potential energy for them, and they will not climb the potential energy hills to the left or right. Fig. 6D is the potential energy for electrons. They are concentrated in the region of lowest potential energy for them. They will not climb the potential energy hills to enter the *p*-type germanium. The result is that there is no current flow of holes or electrons under equilibrium conditions. For transistor applications the *n-p-n* transistor is biased normally as indicated in Fig. 7A. The *p-n* junction between the emitter and base is biased in the forward direction. The *p-n* junction between the base and the collector is biased in the reverse direction. The potential energy diagram for electrons when no signal is applied is shown in Fig. 7B. (In *n-p-n* transistors the major current carriers are electrons, and for that reason the potential energy diagram for holes is not presented). The application of forward bias between the emitter and the base substantially reduces the potential energy hill at the left *p-n* junction. As a result some electrons will climb this hill and enter the *p*-type germanium. Since the base strip is relatively thin, most of the electrons which enter it will not combine with holes, but will pass through the strips and easily go down the potential energy hill at the right junction. This steep hill which favors the entrance

Fig. 7. An "n-p-n" structure under operating conditions. See text for discussion.


e
N
P
N
C
(A)
POTENTIAL ENERGY OF AN ELECTRON
(1)
(2)
(B)
NO SIGNAL
(C) SIGNAL APPLIED. BASE MORE NEG. TO EMITTER
(D) SIGNAL APPLIED. BASE MORE POS. TO EMITTER



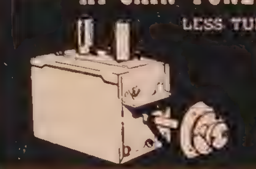
THE *Case* WITH A 1,000 APPLICATIONS

This all-purpose case
is ideal for housing meters,
controls and switches
of all types.
Made of heavy molded
block plastic with
matching phenolic panel.
Easy to drill and saw.
Available in two sizes;
5-1/4" x 6-7/8" x 2-5/16"
3-3/4" x 6-1/4" x 2"

Ask your Distributor for
Waldom's Plastic Case.

WALDOM
ELECTRONICS INC.
911 Larrabee St., Chicago 10, Ill.

HI-GAIN TUNER-BOOSTER



LESS TUBES WITH DIAL **$4.75**

COMPLETE WITH TUBES **$6.00**

Solve poor T.V. reception with a Hi-Gain Booster. Banish weak fringe areas, reduce snow. This unit comes to you as a highly serviceable High-Gain Tuner. Uses 6J6 Tubes in very efficient Hi-Q Circuit. Has 8 tuned circuits using pure silver inductances and individual compensation providing high gain on all channels. Built in 5:1 Vernier Drive. This is a complete departure from ordinary tuners.

All necessary parts and instructions are included to convert this unit in a few minutes to one of the highest gain boosters on the market regardless of price.

100 ASSORTED RESISTORS
Carbon insulated. New in current RMA Values 5%, 10% and 20% in ½, 1 and 2 watt **$1.00**

Shipments sent postpaid when full payment is enclosed with order. 25% deposit on C.O.D. shipments. Open account privileges to rated firms. Send for our new bulletin listing many T.V. Components at terrific price reductions.

FRANK W.
DE GRAY
AND ASSOCIATES
11842 WEST JEFFERSON BOULEVARD
CULVER CITY, CALIFORNIA

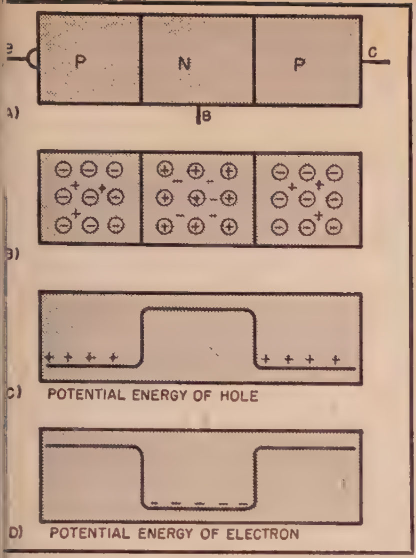


Fig. 8. A "p-n-p" structure under conditions of equilibrium. Refer to Fig. 6.

electrons from the base strip to the ype germanium of the collector is oduced by the reverse bias between e collector and the base.

If a signal is applied which makes e base more negative with respect the emitter (opposes forward bias), e potential energy diagram will ange to that shown in Fig. 7C. The tential energy hill between the emit- r and the base is increased, and as result fewer electrons will climb the l to enter the *p*-type germanium. wever, those that do enter the *p*- pe germanium will not recombine th holes but will easily fall to the lector region of low potential en- gy.

If a signal is applied which makes e base more positive with respect to e emitter (aids forward bias), the tential energy changes to that of g. 7D. The potential energy hill be- een the emitter and the base is de- eased and as a result more electrons ompared to the number which flow en no signal is applied) will flow o the *p*-type region. Most of these ctrons will not combine with holes t will flow easily to the low poten- l energy level of the *n*-type ger- anium on the right.

The operation of the *n-p-n* junction ansistor can be compared to the op- ation of a triode vacuum tube. The nitter is equivalent to the cathode, e base to the grid, and the collector the plate. Practically all the elec- ons which emerge from the emitter athode) go to the collector (plate). e base (grid) current is extremely hall, consisting only of a small num- r of electrons equal to the recom- nation number of holes and electrons the *p*-type region. It is interesting note that two types of current are volved in the vacuum tube and two pes of current are involved in the ansistor. The thermionic electrons hose boiled off the cathode) of the be are equivalent to the excess elec- ons from the emitter. The small nduction current of electrons (those

ATR

for A.C. current

ANYWHERE!

STANDARD and HEAVY DUTY

INVERTERS

For Inverting D. C. to A. C. ...Specially Designed
for operating A. C. Radios, Television Sets,
Amplifiers, Address Systems, and Radio
Test Equipment from D. C. Voltages
in Vehicles, Ships, Trains, Planes
and in D. C. Districts.

See your jobber or write factory

ATR

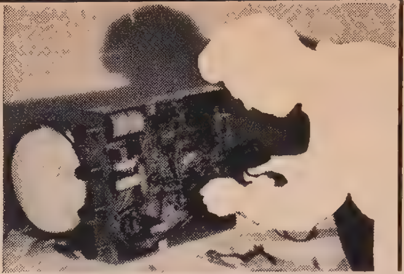
✓ NEW MODELS
✓ NEW DESIGNS
✓ NEW LITERATURE

"A" Battery Eliminators, DC-AC Inverters, Auto Radio Vibrators

AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
SAINT PAUL 1, MINNESOTA—U. S. A.

Let MILTON S. KIVER Help You Prepare For U.H.F.-TV And...

TELEVISION SERVICING



Easy to TRAIN AT HOME This Practical Way!

Men with the right training in Television Servicing are in big demand . . . pull down big pay. T.C.I. TRAINS YOU RIGHT with easy-to-follow technical training designed *by* servicemen, *for* servicemen! You learn practical, professional type Television Servicing without leaving your present job. Included are money-making extras such as set conversion, master antenna installation, U.H.F.-TV and field servicing short cuts. You can start earning Television money after the first few lessons. You learn to test, trouble shoot and repair all types of TV sets the proven, *practical* way!

HERE'S HOW YOU GET EXPERIENCE!

You train on your own large screen modern television receiver, furnished as part of your course. This set is yours to keep! As an optional feature you can get two weeks of actual field experience out on service jobs and on the repair bench for Chicago's largest independent servicing organization. You learn Television Servicing by *actually doing* Television Servicing . . . you get the *practical* know-how you need to qualify for BIG MONEY in this fast-growing field! **Age is no barrier, Many TCI students are over 40!**

VETERANS! T.C.I. is approved for G.I. training under Public Law 550. Check coupon.

ACT NOW! Mail coupon for FREE Catalog and SAMPLE LESSON. Write TODAY!

YOU GET and keep modern large screen Television receiver.
YOU DO actual testing, servicing, trouble shooting and repairing

TV BROADCASTING COURSE READY NOW!
Train at home for these big pay studio jobs! Video engineers, cameramen, microwave engineers, etc. Easy non-mathematical training covers all phases. Write!

MAIL NOW FOR FREE BOOKLET

MILTON S. KIVER, President
TELEVISION COMMUNICATIONS INSTITUTE
205 W. Wacker Dr., Dept. I-AM, Chicago 6, Ill.

Rush full facts on the course checked below. I am not obligated. Salesman will not call.

☐ TV Servicing ☐ TV Broadcasting

Name.............................. ☐ Veterans: check here

Address ....

City.................... Zone.... State.......

☐ BEGINNERS check here for information on Pre-Tel Radio Course.

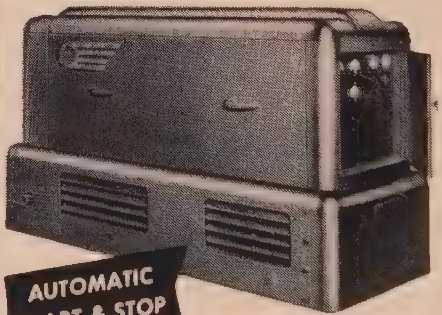
TELEVISION COMMUNICATIONS INSTITUTE
205 W. Wacker Dr., Dept. I-AM Chicago 6, Ill.

The Leader

Perma-Power Battery Eliminator
for 1½, 2 and 6 Volt Radios

mfd. by
Perma-Power COMPANY
Chicago 25, Illinois
Manufacturers of Electronic Equipment Since 1928

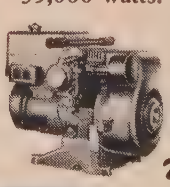
STAY ON THE AIR WHEN POWER FAILS...with an ONAN Electric Plant



AUTOMATIC START & STOP

Model 10EL, 10KW A.C.

When storms, floods, or fires interrupt electricity and force you off the air, you lose listeners and income. Guard against loss, assure vital public service during emergencies by installing an Onan Electric Plant. Onan Standby Electric plants serve many network and private stations. Automatic models to 35,000 watts.



PORTABLE ELECTRIC PLANTS FOR MOBILE RADIO USES
Supply A.C. power for broadcasting at scene of events. Light in weight. Can be carried by hand or in trunk of car. A.C. models: 400 to 3,000 watts.

Write for FREE Folder

D. W. ONAN & SONS INC.
7897 University Avenue
Minneapolis 14, Minnesota

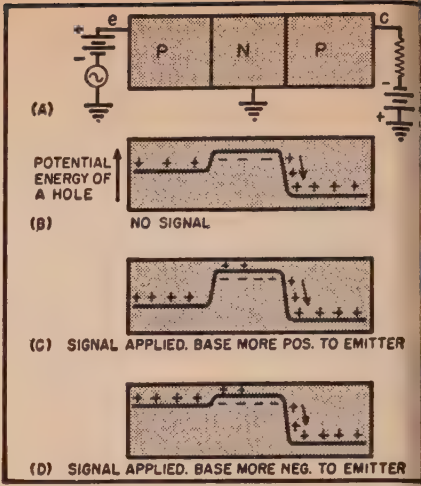

e
c
P
N
P
(A)
POTENTIAL ENERGY OF A HOLE
(B)
NO SIGNAL
(C) SIGNAL APPLIED. BASE MORE POS. TO EMITTER
(D) SIGNAL APPLIED. BASE MORE NEG. TO EMITTER

Fig. 9. A "p-n-p" structure under operating conditions. See text for full details.

which flow in and out of the grid control plate current) is equivalent the small current of holes in the bas region (which increase or decrease control collector current).

A *p-n-p* junction transistor is forme by placing a narrow strip of *n*-typ germanium between two relativel long strips of *p*-type germanium, shown in Fig. 8A. Low-resistance co tacts are made to each strip, and a designated *e*, *b*, and *c*, which stand f emitter, base, and collector, respe tively. Figs. 8C and 8D are equivaler to Figs. 6D and 6C respectively, e cept that in the *p-n-p* transistor th hole plays the role that the electro played in the *n-p-n* transistor. Fig 9A, 9B, 9C, and 9D, are also equi alent to Figs. 7A, 7B, 7C, and 7 Note that in order to bias the *p* junction between the emitter and th base of the *p-n-p* type transistor the forward direction, the emitt must be made positive with respect the base. To bias the collector in th reverse direction (Fig. 9A), the colle tor must be made negative with r spect to the base. It is obvious th the explanation of the operation the *p-n-p* transistor (where the hole the major current carrier) is the e cess electron.

(Concluded next month)

HAM CLUB MEETINGS

THE Cleveland Area Council of Amate Radio Clubs is holding a basket picn on Sunday, July 26th from 1300 un dark. The affair will be held at Roun up Lake Park, on Route 82, about miles from downtown Cleveland.

Registration is $1.00 and further d tails are available from Warren Sladk W/A8GTZ.

AUGUST 8 and 9 have been set W.I.M.U. and C.A.R.S. as the dates the combined hamfest. The event w be held at Big Springs, Idaho, 20 mi south of the west entrance to Yello stone Park. Registration fee is $1. per licensee or family. Cabins, ca grounds, and commercial power a available.

Reservations for cabins should made with the hotels. For a list of su accommodations and additional deta write W7OOY, Secretary, Harlowtow Montana.

—3

echnical BOOKS

VISION RECEIVER DESIGN I" G. W. Uitjens. Published by s *Technical Library,* Eindhoven, ıd. Available in the U.S. from *er Press, Inc.,* 402 Lovett Blvd., on 6, Texas. 177 pages. Price

s first book in the new *Philips* se- f technical treatises covers the of the i.f. stages in a television er.

text material is divided into main sections covering the gain andwidth with two-terminal cou- networks; the response curve of mplete amplifier; distortion; gain, idth, and distortion with four- ıal coupling networks; noise; ıck; and practical considerations on the theory.

le the author's style is thor- y readable, the treatment of the t matter is at an engineering and a working knowledge of tele- circuitry and a comprehensive standing of mathematics are pre- ite.

s volume deals with the applica- f the pentode in the i.f. section superheterodyne television re- and h.f. amplification in a t.r.f. sion receiver.

second volume of this series will flywheel synchronization of saw- generators.

* * *

E-MECUM" edited by P. H. Published by *P. H. Brans, Ltd.,* rp. Available in the U.S. from *s and Engineers, Ltd.,* Box 689A, Barbara, California. 304 pages. dition (1953) Paper bound.

volume is a supplement to the dition ("Radio Tubes") and an uctory section to the 11th Edi- hich will cover television tubes. ree volumes (or editions), taken er, will provide the user with ıplete listing of tubes for all ses.

text material is divided into four which list the original tube and ential substitute; original tubes eir near equivalents; special and al tubes and their equivalent amilies; and military tube desig- s for all countries.

with all of the "Vade-Mecum" ıs, the instructions for using the are given in several languages, ng English, French, German, Italian, Spanish, etc.

ineers, experimenters, or hams work involves the use of equip- or tubes from other countries ıd this publication of great as- e.

* * *

MANUFACTURERS' RECEIVER BLE CURES" edited by Milton zer. Published by *John F. Rider her, Inc.,* New York. 110 pages. $1.80. Paper bound. Volume 2.

This is the second of the series of handbooks covering suggested receiver changes as made by the manufacturers of the TV sets in question.

Volume 2 covers receivers manufactured by *Emerson, Fada, Firestone, Freed, Gamble-Skagmo, General Electric, Hallicrafters, Hoffman, Industrial TV, International TV,* and *Jackson.* Subsequent books will cover additional sets.

As with the first volume, the service notes are presented in concise form with partial schematics or pictorial diagrams being included where required.

* * *

"HEARING AIDS, THEIR USE, CARE AND REPAIR" by Matthew Mandl. Published by *The Macmillan Company,* New York. 155 pages. Price $3.50.

Although this text is addressed primarily to the wearers of a hearing aid, the material incorporated is also of interest to service technicians who repair and service such electronic devices.

The author describes typical hearing aids now in use, outlines the problems and adaptation techniques for the new user, describes the various methods of wearing the device, care of the hearing aid, battery care and storage, the making of minor repairs, the electronic repair factors, servicing procedures and typical troubles, and future trends in the development of hearing aids.

The material on servicing includes a listing of the test equipment required, servicing materials needed, replacement parts to be stocked, servicing precautions, testing methods, continuity and resistance measurement, signal tracing, and listening tests. The various tube types used in hearing aids are also discussed.

The technician who handles this type of service work will want a copy of this book for reference.

* * *

"PIX-O-FIX TV TROUBLEFINDER GUIDE" by Alfred A. Ghirardi & R. G. Middleton. Published by *Rinehart Books, Inc.,* New York. Price $1.00.

This handy and compact guide carries 24 TV trouble-pictures on a revolving wheel. By matching the picture on the receiver screen with the picture in the guide a corresponding key number can be obtained which is the clue to the next step.

With the proper key number the user can then refer to the corresponding pull-out card which lists the possible causes and remedies for this condition.

Most of the common television receiver faults have been included in the guide so that the service technician will find the bulk of his troubleshooting problems covered in this compact form.

—30—

The price of the book "Sound Reproduction" reviewed in the June issue should have been $3.85 not $6.75 as quoted.

Heard...

but not Seen

American's 25th year of leadership in the design and manufacture of quality microphones. Pioneers of the attractive "full vision" design of quality microphones to be heard but not seen. Enjoy perfect performance . . . plus . . . full vision for both artist and audience.

Write for Free Catalog 46

American
MICROPHONE CO.
370 S. FAIR OAKS AVE., PASADENA 1, CALIF.

"In music,
listening quality
is
everything...

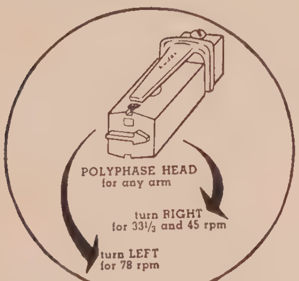
1 It is the No. 1 MUST. Without it everything else becomes meaningless. The AUDAX CHROMATIC has that quality to a degree not equalled by any other pickup" . . . *so says the violinist, David Sanger, of amplifier fame* (*Toscanini's NBC Symphony*).

2 Be it diamond or sapphire, every stylus has a limited life-span; the diamond lasts the longest. Obviously, then, replaceability of the stylus—at home, is of the greatest importance.

ONLY AUDAX PROVIDES REPLACEABILITY — AT HOME — OF EITHER STYLUS, INDEPENDENTLY OF THE OTHER.

3 The revolutionary new records are so true to the original that almost any pickup is bound to give some results . . . but —it takes a reproducer of the highest order, one sensitized to the nth degree . . . a CHROMATIC POLYPHASE—to bring out every subtle shading, every nuance so essential to the real music of which these discs are capable.

But . . . only YOU can decide what sounds best to you. Therefore, See and Hear the Audax CHROMATIC and—You be the judge . . . yet Audax costs no more than ordinary pickups.



One single magnetic unit plays all home records.

Available with the new Compass-Pivoted Audax arms and to fit the high quality record changers.

* *#84 in 1953 ELECTRONIC PHONO FACTS now obtainable from your dealer*

AUDAK COMPANY
500 Fifth Avenue, New York 36
Creators of Fine Audio-Electronic apparatus for over 25 years

"The Standard by Which Others Are Judged and Valued"

International Short-Wave

(*Continued from page 66*)

Chile—CE960, 9.593 Santiago, opens 0645 with identification signal, chimes, and rooster crowing; program begins 0650. (West, Va.) Noted in Britain 2030 with chimes and call "Radio La Americana." CE1190, 11.939A, Valparaiso, heard with music and Spanish announcement 1845, fair level. (Catch)

China—Radio Peking noted on 10.200 at good level in *English* 0400; heard on *measured* 9.0298 at 0535, fair level; picked up on 6.200 around 0430 in *English* (some days parallel with 6.100, others not). (Ballou, Calif.) Heard in Chinese 2000 on 15.06AV and 11.685AV, weak to fair. (Balbi, Calif., others)

Colombia — Brown, Colo., reports HJKH *testing* on 5.070 recently with *English* identification around 2200.

Costa Rica—"La Voz de America en Costa Rica" recently has been on 6.166 from 6.172; announces 6.165; is QRM'd from 2015 by Berne, Switzerland. (Stark, Texas)

Denmark—OZF, 9.52, noted 2112-2130 closing in *English,* good level; announces *English* for North America 2030-2130, 2200-2300. (Roberts, Conn.)

Dominican Republic—HI9T, *Broadcasting Tropical,* Puerto Plata, has returned to 6.190 after a sojourn to 6.215A. (Niblack, Ind., others)

Dutch New Guinea—Radio Hollandia, 7.126, noted in Sweden around 0515-0530. (*Nattugglan,* Sweden, and others)

Egypt—Cairo, 11.815, noted signing on 1320 with march, then news in French; 1330 news in *English,* 1340 Greek, 1350 Italian. (Pearce, England) Noted opening on 9.75 parallel 6.085A at 2300 with bells striking, then setting-up exercises (Arabic). (Bellington, N. Y.) SUX, 7.852A, noted closing Arabic session 1700; fair level in N.C. (Earnhardt)

Ethiopia — Radio Addis Ababa, 15.06A, noted 1310 with popular music; news 1330; should close 1430. (Pearce, England)

France — Excellent signal noted from Paris, 17.85, at 0945; off 1000. (Bishop, Ohio)

French Equatorial Africa—Brazzaville, 11.97, 9.44, noted with *English Lesson* prepared by *Radiodiffusion Francaise,* Paris, at 1345. (Pearce, England) News noted on these channels 1745. (Gerran, N.Y.)

French Guiana — Radio Cayenne, 6.198A, seems to close now 1815 although schedule is listed 1730-1830. (Stark, Texas)

French Morocco—Mercier, France, reports *Radio Maroc,* 7.215, Rabat, closing 0900. (*Nattugglan,* Sweden)

Germany — The (West) German Overseas Service, 6.270, noted 2100 with German and *English* announcements; asked for reports to Radio Cologne, Germany. (Bellington, N.Y.)

Greece—Radio Athens, 11.718, is

20" Console
$149⁹⁵
Pl. $15.00 Fed. Excise Tax

17" Table
$122⁶⁸
Pl. $12.27 Fed. Excise Tax

Check these luxury features: Ultra sensitivity, dynamic range control, UHF adaptability, Duo power supply, Acousticlear Sound system . . . all in a beautiful Mahogany finish cabinet.

20" Table
$134⁵⁰
Pl. $13.45 Fed. Excise Tax

21" Console
$164⁹⁵
Pl. $16.50 Fed. Excise Tax

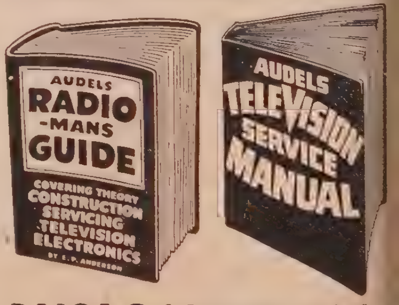
ALSO AVAILABLE TV CHASSIS
All sets have full 1-yr. factory picture tube warranty, and standard 90-day RTMA parts warranty. Mail and Phone Orders Filled. $25 deposit, balance C.O.D., Shipping Charges Additional.

STEPHEN SALES CORP.
45 Crosby St., N.Y. 12, N.Y. Phone: WO4-8233

Dealer Inquiries Invited

AUDELS
T.V.-RADIO SERVICE LIBRARY

HERE IS LATE INFORMATION IN A HANDY FORM FOR RADIO & TELEVISION REPAIRMEN, SERVICEMEN & STUDENTS



2 VOLS. $6 COMPLETE PAY ONLY $1 A MO.

IT PAYS TO KNOW!

AUDELS T.V.-RADIO SERVICE LIBRARY presents the important subjects of Modern Radio, Television, Industrial Electronics, F.M. Public Address Systems, Auto, Marine & Aircraft Radio, Phonograph Pick-Ups, etc. Covers Basic Principles—Construction—Installation — Operation — Repairs — Trouble Shooting. Shows How to get Sharp, Clear T.V. Pictures. Install Aerials—How to Test. Explains Color Systems & Methods of Conversion. 1001 Facts—Over 1260 Pages—625 Illustrations—Parts & Diagrams—Valuable for Quick Ready Reference & Home Study. Tells How to Solve T.V. & Radio Troubles—Answers T.V. & Radio Questions.

Get this information for Yourself.
7 DAY TEST—ASK TO SEE IT!

MAIL ORDER

AUDEL, Publishers, 49 W. 23 St., N.Y. 10
Mail AUDELS T.V. RADIO SERVICE LIBRARY 2 Vols. $6 on 7 days free trial. If O.K. I will remit $1 in 7 days and $1 monthly until $6 is paid. Otherwise I will return them.

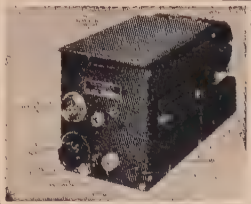
Name__________
Address__________
Occupation __________
RN
Employed by __________

ly reported with *English* 1245-
Is beamed then to England.
bard, Mass., others) Central
es Radio Station, 7.420, Athens,
d signing on 1030 (Sun. 1000)
march-anthem (sung); closing
after call in Greek by woman;
noted as early as 0155 tune-in
still going 0425 tune-out. Kozani,
A, noted 1740 with light music,
ng 1800 after call, with anthem
g). (Pearce, England)
adeloupe — Basse-Terre, 9.435A,
noted 1745-2000; some days is
heard around 0600-0630 sign-off.
st, Va., others)
atemala — TGNB, 9.668, noted
ing to 2348 closedown on a re-
Wed. (Ballou, Calif.) TGWA,
noted 2330 at excellent strength
Mass. (Golden) Heard a recent
with *English* on 15.17 at 1815-
(may also be Wed., Fri.). (Ni-
k, Ind.)
iti—4VRW, 10.065A, is still strong
Britain from 1600 onwards.
rce) 4V2S, Port-au-Prince, noted
ntly on 5.845 instead of 5.945 with
rdings from 1600 tune-in. (Saylor,

ng-Kong — ZBW3, 9.525, noted
with news. (Sanderson, Austra-

ungary — *Radio Budapest,* 9.833,
d 1630 relaying *Radio Moscow;*
own *English* transmission 1730-
closing. (Roberts, Conn.) Good
his channel in *English* 2030. (Bal-
Calif.)
dia—AIR, 11.85, noted with news
into Tamil 1940. (Roberts,
.) VUM2, 4.920, Madras, heard in
and by Fairs 1050 in Home Serv-
relay of Indian music. (URDXC)
do-China (Vietnam) — *Radio*
ce-Asie, 9.745AV, Saigon, noted
ng French transmission 1030; re-
ing for Europe with "La Marseil-
" 1035, followed by news in
ch; *English* 1100-1130 closedown;
unces next *English* for 1830 on
. (Pearce, England) *Radio France-*
11.925, noted 1000 with record-
announcements in both *English,*
ch; good level. (Ballou, Calif.)
d with news on this channel 2100.
ce of Vietnam," 7.288, heard with
in Vietnamese at 0615. (Sander-
Australia) On 9.620 at 0520, fair
in Calif. (Ballou)
ael—*Kol-Israel,* 9.010A, is now on
ner schedule—has *"Voice of Zion"*
on (*English*) 1515-1600 closedown;
also 1415. 4XB44, *Galei-Zahal*
eli Forces Station), 6.725, Tel
noted 1345 with light music;
by woman 1400, then closed with
sounding "Lights Out;" this is
ner closedown. (Pearce, England)
ly—Rome, 9.63, noted with *Eng-*
from around 1230; signing off
on 21.560; back 1045 to South
a in *English.* (Bishop, Ohio)
d to North America on 9.57,
5A at 1900-2200; news 1920, 2145.
Smith, Mich.)
ry Coast—*Radio Abidjan* has *new*
lule for 7.215, 600 watts, of 0145-
0715-0800, 1330-1600 in French,

FOLLOW **ARROW** FOR **BIGGEST**
STOCK AT LOWEST PRICES
- RADAR—TRANSMITTERS
- RECEIVERS — TUBES — PARTS



234-258 MC RECEIVER

11-tube UHF tunable receiver with schematic. Like new.

$17.95

Rack $3.50
Control Box.. 1.50

RADAR TEST EQUIPMENT

TS-3, TS-12, TS-13, TS-15, TS-33, TS-34, TS-35, TS-36, TS-45APM3.

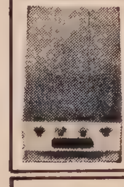
→ → → → FOLLOW ARROW TO GET HIGHEST PRICES FOR YOUR NEW AND USED RADIO GEAR! What have you to sell? WRITE TODAY!

Monthly Specials!

RT-34/APS-13 420 MC. TRANSCEIVER with 5 stages of 30 MC. IF amplifier strip. Less tubes & R.F. section. With dynamotor.. **$6.95**

BC-604 30 W. FM TRANSMITTER. For 20-27 MC. band. Ideal for 10-11 meters. Complete with tubes, temperature controlled crystal oven and technical manual with all instructions for BC-603 and BC-604. Less dynamotor and crystals. Excel. cond. $12.95

AN/APS-3
Airborne radar set. Now complete. .P.U.R.
AN/APR-4
Receiver & tuning unit.............P.U.R.
AN/APS-4
Airborne radar. New.
Complete ........................P.U.R.
AN/APS-6
Airborne radar set. New.
Complete ........................P.U.R.



INTERPHONE AMPLIFIER
BC-709-B

A 2-position single stage audio amplifier. Uses 1 tube and operates from self-contained batteries. With Instruction Manual and Schematic. NEW (less batteries)....... **$3.95**

SCR-625 FAMOUS MINE DETECTOR

For prospectors, miners, oil companies, plumbers, etc. New.
WHILE THEY LAST! **$59.50**

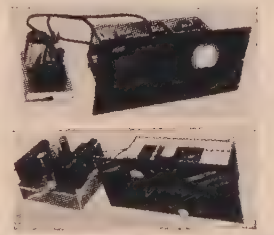
ARC-4 TRANSCEIVER

140-144 MC. Complete with control box, tubes, 12/24 VDC dynamotor with schematic. This is a special reduction for this month only. Like new **$32.50**
MT 101 ARC-4. Rack.....................$6.00

COMMAND EQUIPMENT (SCR-274N)

		Used	New
BC-442	ANTENNA RELAY. Less cond.	$1.95	
	with cond.		$ 3.95
BC-451	TRANSMITTER CONTROL BOX		1.50
BC-450	3-RECEIVER REMOTE CONTROL BOX		2.95
MC-215	MECHANICAL DRIVE SHAFT. Per length		2.95
BC-496	2-POSITION RECEIVER CONTROL BOX		2.95
BC-455	6-9 MC RECEIVER. With tubes	9.95	14.95
BC-454	(3-6 MC) With tubes	9.95	

		Used	New
BC-453	With tubes	$19.95	
MC-211	90° ANGLE COUPLING UNIT.		$0.95
FT-234	MOUNTING RACK for single transmitter	2.95	3.50
FT-226	MOUNTING RACK for 2 Command Xmtrs.		3.95
FT-221	MOUNTING PLATE for **FT-220**		1.50
FT-220	MOUNTING RACK for 3 receivers		2.25
FT-225	MOUNTING PLATE for **BC-456**		2.25
BC-456	MODULATOR. For **SCR-274**		4.50
	Complete set of 4 tubes for transmitter		1.25



C.A.P. SPECIAL COMBO

BC-624 VHF RECEIVER

Freq. range 100-156 MC. Less tubes & crystals, with conversion dope. Used, good cond...... **$19.95**

BC-625 VHF TRANSMITTER

Freq. range 100-156 MC. Less tubes & crystals, with conversion dope. Used, good condition.. **$12.95**

BOTH TRANSMITTER & RECEIVER.
Per set **$29.95**

Miscellaneous Specials!

SURPRISE PACKAGE!
20 lbs. of good, useable radio parts $2.95

HS-18 HEADSET. 8,000 ohms. New	$2.45
HS-23 HEADSET. High imp. New	4.95
HS-30 HEADSET. Featherweight type. Low imp. NEW ....$2.49 USED	1.49
HS-33 HEADSET. Low imp. New	6.95
HS-38 HEADSET. USED, excel. cond	1.49
NEW	3.50
T-26 CHEST TYPE MIKE. New	2.75
T-32 DESK STAND MIKE. New	5.95
LIP MIKE. Navy type. New	.98
PE-125 POWER SUPPLY: Operates on 12 or 24 v. battery. NEW	$17.95
CD-307 EXTENSION CORD. For HS-23-33. NEW	.95
RS-38 MIKE. NEW	4.95
Used	1.75
BC-605 INTERPHONE AMPLIFIER. With dual mike input circuit. NEW	5.95
TELEPHONE REPEATER AMPLIFIERS:	
EE-99, New, with tubes	17.95
EE-89, New	12.95
FL-8 RANGE FILTER	1.95

TUBES!		TUBES!		TUBES!		TUBES!		TUBES!	
16JP4	$19.95	304TH	$8.95	5CP1	$4.95	3FP7	$2.25	9002	$1.65
16AP4	24.95	304TL	8.95	5BP4	4.95	4AP10	1.49	9001	1.65
16DP4	19.95	830-B	2.75	5FP7	2.25	211D	.69	9003	1.65

MP-22 MOBILE ANTENNA. MOUNTING RACK. Comp. with hardware. New. Per Pair $4.95. Ea.	$2.95
TU-17 TUNING UNIT. (2-3 MC.) For BC-223 Xmtr. Used	2.95
I-70 "S" TUNING METER. NEW	2.50
WOBULATOR. See p. 43 Dec. '51 RADIO NEWS	5.95
BC-1023 75 MC. MARKER BEACON RECEIVER. Complete with tubes, mtg. rack. NEW	10.95
TU-25 TUNING UNIT. (3.5-5.2 MC.) For BC-223 Xmtr. Used	2.95
IN-4A L/R TUNING METER. Used	$ 3.95
FL-5 RANGE FILTER	1.25
TS-10 SOUND POWERED HAND SET—Used, excel. cond. Per Pair	14.50
PE-55 DYNAMOTOR 12 V input. 500 VDC @ 200 mils output. New	$24.50
FIELD TELEPHONE. EE-8. Complete BRAND NEW. SPECIAL. ONLY	27.50

TUBES! NEW! ORIGINAL BOXES!
Limited Quantities Available
250TL....Ea. $11.50 250TH.....Ea. $14.50

INDUSTRIAL CORPORATIONS
We carry one of the most complete stocks in U. S. of Military Electronic Equipment, Test Equipment, and Aircraft Electronics. Call or write for free catalogue.

$5.00 MINIMUM ORDER ACCEPTED. All items subject to prior sale. All shipments F.O.B. warehouse. Calif. residents add tax with remittance. 20% deposit required. Please specify shipping instructions with order.
EQUIPMENT WANTED! Highest prices paid for all types of Electronic Gear!

ARROW SALES, INC.
Cable Address: ARROWSALES POplar 5-1810

Mailing Address:
P. O. Box 3878-R, N. Hollywood, Calif.
Office-Warehouse:
7460 Varna Ave., N. Hollywood, Calif.

24 HOUR DELIVERY FROM STOCK!

RELAYS

Our stock of more than a million relays — in over a thousand different types — is the world's largest. Don't delay your production for want of large or small quantities of relays of any type.

Telephone, wire or write for quotations.

NEW AND MORE COMPREHENSIVE
1953 RELAY SALES CATALOG
NOW READY

Be sure to send for your copy

Relay Sales

Telephone
SEeley 8-4146

833 W. CHICAGO AVE.
DEPT. 8, CHICAGO 22, ILL.

Baoule, Ebrie, Dioula; plans *new* studios and other improvements soon. (Scheiner, N. J.)

Japan—Radio Japan, JOA2, 7.180, noted 0600 with news. (Sanderson, Australia) As soon as funds are available, *Radio Japan* will add transmissions for Europe, Brazil. (Scheiner, N. J., others)

Kuwait — "Huna Kuwait," 5.000, noted 1345 in Arabic to closedown after call 1430; no anthem at close. (Pearce, England) Scheduled 0000-0200, 1130-1400 daily; hopes to increase power from 1 kw. to 5 kw. with the installation of new equipment soon; reports to The Broadcasting Officer, Radio Station, Security Department, Kuwait, Arabia, are requested. (Radio Amateur, London)

Madagascar — Radio Tananarive, 9.515, noted signing on in French 2230. (Riggle, Ohio)

Malaya—BFEBS, Singapore, noted closing 1145 on 11.955; closing 0900A on 17.755; heard on 15.435 opening 0915. (Pearce, England) Heard earlier opening on 15.435 at 0400. (Balbi, Calif.) Final closedown noted 1145. (Bishop, Ohio) The Forces Broadcasting Station, 5.010, Singapore, is on the air daily 0700-0900 with *English* identification at start and close; uses 7.5 kw. and signals are beamed "up the Malayan peninsula;" plans to include a British (*English*) session within the next few months. (Radio Australia) At present heard with Swahili, Gurkah, Hindustani. (Sanderson, Australia)

Mauritius—V3USE, 15.075, Forest Side, is heard in Sweden with French musical program *after* 1105 but soon fades out. (*Radioklubben Universal,* Sweden)

Mozambique—CR7BJ, 9.776A, Lourenco Marques, noted from 2300 (Sun. from 0000) with *English* session, many commercials, frequent time checks. (Ferguson, N.C., others) Noted on 3.49A at 1100-1200, good signal; on 4.92A at 1100. (Sarkady, South Africa)

New Zealand—Wellington noted on ZL9, 11,810, parallel ZL3, 11.78, around 2300. (Balbi, Ballou, Calif.)

Nicaragua — Granada, 7.850A, fine level from 1730-2200 sign-off; all-Spanish: CWQRM heavy at times. (Saylor, Va.)

Northern Rhodesia—Lusaka, 4.826, noted with BBC news relay 1300, closing 1402 with "God Save the Queen." (Pearce, England) Heard over the 3.914 outlet around 1115 parallel 7.22. (Sarkady, South Africa)

Norway—Radio Norway, LLR, 7.240, heard Sun. with *English* ("Norway This Week") 0900-0920. (Pearce, England)

Pakistan—Radio Pakistan noted to Indonesia 0600-0715 on 15.270, 17.770; all-native except talk in *English* 0645; news 0200, 0330, 0730 on 17.710; 1015 on 11.885. (Pearce, England) APD1, 15.335, Dacca, heard 2115 with news; Karachi, 17.835, noted 0515 with *English* talk, music. (Sanderson, Australia) Dacca, 15.335, heard with *English* as early as 2030. (Ferguson, N.C.) Noted closing 2100 in *English* on 11.885 to Southeast Asia, announcing 15.335 in parallel. (Niblack, Ind.)

Panama—HP5J, 9.607, Panama City, noted 1930 with request program of popular songs, announcements in *English;* strong level in Ind. (Niblack)

Paraguay—ZPA1, 6.275, Asuncion, noted around 2020-2045 with announcements in Spanish; fair level. (Ferguson, N.C.) ZPA5, 11.950, Encarnacion, has news in Spanish 1650A. (O'Sullivan, England)

Philippines—Dumaguete, noted 0635 with religious session in *English;* news 0700; announced DYH4. (Ballou, Calif.) DUH2, 6.170, Manila, heard signing off 1000 at good level; DYH2, 6.140, Cebu City, noted 0945 with fine level. (URDXC) DZ17, 6.080, is a *new* frequency; DZH4, 6.000, was formerly short-wave outlet of medium-wave DZMB, now relayed by DZ17; DZH4, 6.000, now relays medium-wave DZRH as does DZR2, 9.640; DZ17 operates 1658-1100 daily; news 1730-2345, 0600. (Radio Australia)

Portugal — Lisbon, 15.125, noted often now 1400-1500 parallel 11.996A. With verification, *Radio Renasenca,* Lisbon, listed 6.154, 500 watts, 1430-1900. (Pearce, England) Lisbon noted from 1600 on 11.964A at excellent level but with some QRM from Brazzaville, 11.970, Fr. Eq. Africa. (Scheiner, N.J.) Heard opening 1900 on 5.973A. (Niblack, Ind., others) Good on 15.125 in Portuguese 0600. (Morrison, R. I.)

Portuguese India—Radio Goa, 9.610, is often heard in Sweden 1030 with religious programs in *English.* (Fernell, Sweden)

Rhodes—VOA relays *via "The Courier"* are scheduled currently on 6.015, 1300-1715 to Near East, and 1730-2245 to Caucasian USSR: on 7.200, 1030-1715, 1730-2245 to Caucasian USSR; on 11.805, 0830-1015 to USSR.

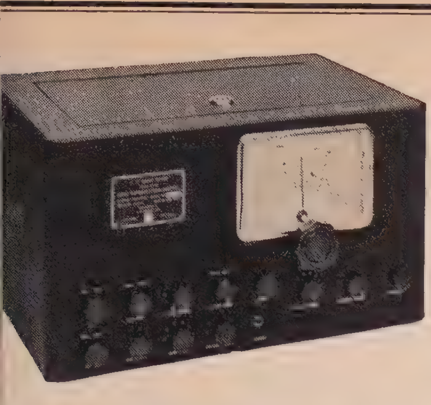
Roumania—Radio Bucharest noted with news, commentary, music from 1500; strong on 12.032, fair on 9.252, 6.218; ends *English* 1545. (Pearce, England)

Saudi-Arabia—Djeddah noted near 7.310 signing on 1118 with march-anthem after interval signal; all-Arabic to 1213 closedown (no anthem). (Pearce, England) Noted here around 2300, evidently *moved* from 7.210A. (Bellington, N.Y.)

South Africa—Johannesburg, 4.945, noted at good level 2315-0000 with request musical session. (URDXC) Heard on 4.897A opening 2345 in Afrikaans, good level. (Cox, Dela.) Johannesburg, 9.870, heard closing 1505 after newscast. (*Monitor,* England)

Southern Rhodesia—Salisbury, 6.000A, is good level in South Africa 1100. (Sarkady)

Spain—Radio Mediterraneo, 6.995A, Valencia, noted 1000 with popular music, call in Spanish; off 1010 (Pearce, England) Malaga, 7.017 noted 1615 with news in Spanish music. (Sanderson, Australia) Madrid 9.363, has *English* for Europe 1515-1545; for North America 1800-184



Contains All Components

Communications Receivers

COMPLETE KIT—This kit is complete with every part necessary to assemble into a finished receiver, including tubes and cabinet. Chassis is punched and marked. Mount the parts, wire it, align it and you have a fine receiver of commercial appearance, that can't be beat for 3 or 4 times the price. Parts layout, schematic diagram and alignment instructions are supplied.

FEATURES:

- 2 Watt P.P. Audio
- Amplified AVC
- Voltage Regulated Oscillator Supply
- Noise Limiter
- Beat Oscillator
- Air Tuned R.F. Trimmers
- 2 Stage Permeability Tuned 455 KC I.F. Plus Crystal Filter
- Phone Jack—Built-in Stand-by Relay
- Operates on 105 to 125 Volts AC or DC Power Source
- Frequency Range 200 KC to 400 KC and 490 KC to 19 MC in Six Bands
- 40:1 Geared Ratio Dial Drive
- 11 Tubes Plus Selenium Rectifier
- 6SG7 RF AMP.
- 6SB7Y Mixer
- 2-6SG7 I.F.
- 6H6 2nd Det & N. L.
- 6SF7 AVC AMP.
- 6SL7 BFO & 1st Audio
- 6SL7 Phase Inverter
- P.P. 25L6GT Audio
- VR-75 Voltage Regulator
- Full Vision Calibrated Dial
- Cabinet 19½" long x 10½" high x 12½" deep
- Finished in fine grain black wrinkle
- Front panel silk screened to identify each control
- Shipping weight 45 lbs.
- Shipped Express Only.

FRONT PANEL CONTROLS

- Tuning
- R.F. Gain
- Audio Gain
- BFO-AVC Switch
- BFO Pitch
- Power On-Off
- Stand-by
- Noise Limiter On-Off and Control
- Antenna Trimmer
- Crystal Filter On-Off
- Crystal Phasing
- Selectivity
- Band Change Switch
- Calibrated Dial Face

Special

$59.50 KIT PRICE EACH

Wired and Tested
$89.50

TERRIFIC KIT BARGAINS

SURPRISE KIT!
Minimum of 5 lbs. of usable, new adio—TV—electronic parts. Comlete satisfaction guaranteed or 00% of purchase price refunded. **$1.99**

aper tubular condenser kit of 100 ew values from .0001 to .1 mfd. 15.00 value for only...... **$5.95**

50 assorted micas in popular values from 10 to 10,000 mmfd. $7.50 value for only............ **$2.95**

15 assorted single, double and triple section FP condensers worth $15.00 for only.......... **$3.95**

25 assorted volume controls $10.00 value for just............ **$2.95**

15 assorted popular size 5 and 10 watt Resistors for.......... **$2.95**

PHONO AMPLIFIER

A 3 tube phono amplifier comlete with tubes and output transformer. Made especially for Bouleard. Uses 50L6—35Z5—12SQ7. A super buy.

$6.95 ea.

COPPER OXIDE RECTIFIERS

radley Labs (CX3E Series) Dual Bridge Rectifiers. Curent and Temperature Characteristics Balanced to Better han 1% from —40°C to 70°C. 10.5 Volts Input. Max. .C. Center Leg Current 15 M.A. Used as Balanced odulators and Bridges. ermetically Sealed **$2.00**

WELLER GUNS

WS-100—Single Heat—100 Watt	8.77
WS-200—Single Heat—200 Watt	9.75
WD-135—Dual Heat—100/135 Watt	10.73
WD-250—Dual Heat—200/250 Watt	11.71

SPECIAL "HI-FI" VALUES

NEW MEISSNER GOLDEN MATCHED HI-FI SYSTEM

AM-FM Tuner—Webster 3 speed changer. GE triple play magnetic pick up. 10 watt Hi-Fi amplifier with built in preamp. Electro-voice 12" Co-Ax speaker complete with all plugs and mounting board. Ready to play **$199.95**

BRITISH 10" ELAC HI-FI SPEAKER 6 WATT—8 OHM VOICE COIL ....Ea. $9.95

NEW GARRARD MODEL RC80 3-SPEED AUTOMATIC RECORD CHANGER $41.46

Hallicrafters—A-84—15 Watt Amplifier **$99.50**

Hallicrafters—ST-83—AM-FM Tuner	$129.95
McIntosh—A-116—30 Watt Amplifier	$139.50
Craftsmen—C-500—15 Watt Amplifier	$99.50
Craftsmen—C-10—AM-FM Tuner	$131.50
Pickering Long Play Cartridge for 33⅓ RPM with Diamond Needle	$36.00
GE Diamond Replacement Needle	$16.17
Jensen H-222 12" Co-Axial Speaker	$46.75
Jensen G-610 15" Tri-Axial Speaker	$224.91
3 Speed/Phonograph with Leatherette carrying case 2 tube amplifier	$21.95

Boulevard Special!

V-M Model 950 RECORD CHANGER

ri-A-matic, 3 speed, flip-over ual needle crystal cartridge, list **$46.50**

our Cost, Only....... $28.95

TUBE KITS

BEST BRANDS AT BEST PRICES

V4, 1T4, R5, 1S5	$2.19
Q4, 1T4, 1R5, 1S5. ist Value $8.00. Tube Kit only..........	$1.98
S4, 1T4, 1S5, 1R5. ist Value $7.80. 4-Tube Kit.............	$1.98
U4, 3S4, 1S5, 1R5. List Value 7.80. All Four Tubes for	$1.98
17Z3, 1U5, 3S4, 1R5, 1T4. C-DC Portable Kit. All for..............	$2.49
2AT6, 12BA6, 12BE6, 35W4, 50B5. Tubes for	$2.59
OL6GT, 35Z5GT, 12SQ7GT, 12SK7G, 2SA7G. 5 Tubes for....................	$3.22

RECEIVING TUBE SPECIALS

Manufacturer's Surplus—Boxed—Fully Guaranteed

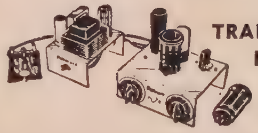
SN7GT	.88c	12AT6	.60c
AU6	.65c	12BA6	.69c
SQ7	.60c	12BE6	.69c
6GT	.60c	35Z5	.54c
4	.54c	50B5	.69c
AL5	.59c	50C5	.69c

e Carry a Full Line of CBS-Hytron and National Union Receiving and Picture Tubes at Regular Discounts.

TEST EQUIPMENT

co Latest—Model 470—7" Push-Pull Scope Kit	$ 79.50
Factory Wired	129.50
recise 7" Scope Kit Model 300K..........	94.95
Factory Wired Model 300W..............	199.50
MC—Model 204 Tube Checker..............	55.90
MC—Model 205 Tube Checker.............	47.50
MC—Model 206 ube Checker. $81.83	

PHILMORE KITS at Lowest Prices!



Novice TRANSMITTER and POWER SUPPLY KIT Including Key!

25 watt input, 2 band operation, 3.7 MC to 3.75 MC and 26.96 to 27.23 MC; has crystal oscillator, tuned output amplifier. Easy to assemble . . . includes pictorial diagrams, tuning condensers, tubes, power supply, receivers, instruments, etc.
Only **$29.40**

ONE-BAND MODEL

RADIO KIT 550 to 1600KC.. **$19.11**

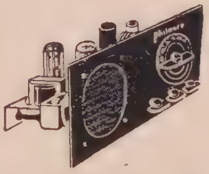
TWO-BAND MODEL

RADIO KIT 550 to 1600KC and 5.5 to 16MC.. **$22.34**

5 TUBE SUPER HET RADIO KITS AS ABOVE AT THESE LOW, LOW PRICES.

Simple pictorial diagrams make these kits really easy to assemble. Supplied with chassis, colorful cabinet, all necessary parts ready to assemble. 115V AC or DC. Size: 8¾" x 5⅞" x 5½".

ORDER YOUR KITS TODAY



2-tube AC-DC RADIO KIT

Includes simple instructions and diagrams, complete less tubes, headset, wire and solder. 115V AC or DC **$7.35**

Set of tubes: 35Z5 and 12SJ7......$1.51

3-TUBE AC-DC RADIO KIT

2 band including short wave . . . Easy to assemble; with good 4" PM Speaker, 550-1700 KC on broadcast band; 6-18MC on short wave. 115V AC or DC. Complete with speaker, less tubes ....ONLY **$11.76**
Set of tubes: 35Z5, 50L6, 12SJ7............$2.39

RADIO CRAFTSMEN

Model 202

HIGH FIDELITY TV CHASSIS

202 Chassis, only	$252.50
Tube mounting kit	21.40
21FP4A (standard brand warranteed tube)...	40.00

BUY all 3 above and save $15.00 on tube. ....complete **$298.90**

TV ANTENNA SPECIAL!

Here's a real bargain in a quality all band in-line antenna complete with 5 ft. mast for only........ **$5.95 ea.**

TV PICTURE BRITENER

For correcting soft, dark or weak picture tubes. ONLY .. .. $1.95 EA.

BAT HANDLE TOGGLE SWITCHES

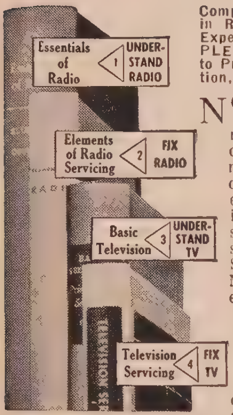
Bakelite insulation and silver-plated lug terminals on all units. SPST type rated at 3 amps. 250 volts. All others 3 amps. 125 volts. Underwriters' Laboratories Approved. Shank 15/32" dia., 15/32" long. With mounting nuts.

Stock No.	Mfrs. Type	Poles	NET EACH	Lots of 10 EACH
R125	20994-LH	SPST	51c	46c
R126	21350-EH	SPDT	56c	50c
R127	20902-CX	DPST	76c	69c
R128	20905-FR	DPDT	88c	79c

TERMS: 25% Deposit with order. Balance C.O.D. Include postage with parcel post orders. All prices F.O.B. Chicago and subject to change without notice. All merchandise subject to prior sale.

BOULEVARD ELECTRONICS, INC.
808-10 W. JACKSON BOULEVARD • CHICAGO 7, ILLINOIS
DE 2-4458
RADIO AND TELEVISION SUPPLIES

NOW! BECOME EXPERT AT RADIO-TELEVISION IN 4 EASY STEPS!



Complete Self-Training Library in RADIO and TV by Famous Experts — Takes You BY SIMPLE STEPS From Basic Theory to Problems of Repair, Installation, Color TV, etc.

NOW you can do ANY Radio-TV installation, service, or repair job like an expert; operate field-testing equipment; understand problems of TV, FM-AM transmission, etc. Step into a good-paying job—or start your own service business. Train yourself AT HOME . . . IN SPARE TIME . . . with the McGraw-Hill Radio and Television Servicing Library.

2296 Pages—
1611 Illustrations

The men who wrote this complete 4-volume Library are among the outstanding radio and TV instructors in America today. Every detail is clearly explained in over TWO THOUSAND PAGES of step-by-step instruction and over SIXTEEN HUNDRED "how-to-do-it" illustrations, cross-section diagrams, etc. The review questions and answers "nail down" everything you learn. At-a-glance "trouble-shooting" charts show how to diagnose instantly any radio or TV breakdown . . . and how to repair it expertly and quickly.

The Library will pay for itself many times over. It gives all you need to know for FM and TV in the FCC's 1st-class license exam.; gives an experienced technician more confidence and skill.

SEND NO MONEY

Mail coupon below to examine complete four-volume Library FREE for 10 days. No obligation. Or you may examine **individual** books FREE for 10 days by checking the proper boxes in coupon.

PARTIAL CONTENTS

ESSENTIALS OF RADIO.
800 pages, 433 illus.
Circuit Analysis • Vacuum Tubes • Circuits: Detector • Amplifier • Tube Oscillator • Power Supply • Transmitting, Receiving • Etc.

ELEMENTS OF RADIO SERVICING.
475 pages, 375 illus.
Multimeters • AC Power Supply • Speakers • Antennas • Auto Radios • Push-Pull Output Stage

BASIC TELEVISION.
592 pages, 415 illus.
Scanning • Synchronizing • Video Signal • Brightness Control • DC Reinsertion • Picture • FM Alignment • Picture Tubes • VHF and UHF transmission • Reception

TELEVISION SERVICING.
429 pages, 388 illus.
Antennas • Transmission Lines • Test-pattern and Picture Analysis • Localizing Reception Troubles • Interference Remedies • Deflection Circuits . . .
AND MUCH MORE!

FREE 10-DAY TRIAL COUPON

McGRAW-HILL BOOK CO., Inc., Dept. RTN-7
327 West 41st St., New York 18, N. Y.

☐ Send me for 10 day free examination the Radio and TV Servicing Library, 4 Vols. (Regular retail price is $26.75; Special Course Price only $21.95 in easy installments.) If not satisfied with Course, I will return it, pay nothing. Otherwise, I'll send $1.95 plus delivery then and only $4.00 in monthly installments. If you wish to examine any of these books individually, check below the ones you wish us to send you for 10 Days' FREE EXAMINATION:

☐ Essentials of Radio, $7.50
☐ Elements of Radio Servicing, $5.25
☐ Basic Television, $7.50
☐ Television Servicing, $6.50

For any book I keep, I'll send $2.00 plus delivery in 10 days, balance in easy monthly installments.

Name ....
Address ....
City.................... Zone.... State......
Position ....
RTN-7
Company ....

☐ **WE PAY FOR DELIVERY** if you send first payment of $1.95 when ordering Library or full price when ordering individual books (prices above). Same return privilege. *(Offer applies to U.S.A. only.)*

2205-2245. (Carroll, Me.) "La Voz de la Falange," 7.380, noted in Sweden at 1500. (Englund)

Surinam—Paramaribo, 5.752, 15.404A, noted with news in Dutch by man 1815. (Cox, Dela.)

Sweden — *Radio Sweden,* 11.880, strong level 2300 with news. (Ballou, Calif.) Heard with news to Far East 1800-1815 on 9.535; same channel 1930-2000 in *English* to Canada, USA. (Parsons, Pa.)

Syria—Damascus, 11.913A, noted with *English* for Western Europe 1630-1730 closedown. (Parsons, Pa.)

Taiwan—Taipeh, 7.130, noted 0550, fair level with deep fading. (Ballou, Calif.) Noted on BED26, 10.080, at 1700 with Chinese news, music; BED24, 9.820A, at 0445 with Chinese news; BED6, 11.735, at 2345 with news, music, then Chinese session from 0000. (Sanderson, Australia)

Thailand—Bangkok, 7.103A, noted 0555 at good level in native session. (Ballou, Calif.)

Station sent schedule as Overseas Service (omni-directional) 0500-0625, news 0515, in Malay 0600, on HSK5, 6.240, 1 kw.; HSK7, 11.910, 500 watts, and HSK8, 15.640, 250 watts; Home Service 1900-2000, 0630-1020, 827 kc., 10 kw.; 7.140 (actually 7.105A), no power mentioned; 6.240, 11.910, 15.640. (Scheiner, N. J.)

Trinidad—*Radio Trinidad* lists current schedule on 3.275, 790 kc. at 0500-2200; on 6.085 at 0500-1700; no mention of 9.625. (Pearce, England; Johnson, Ohio) Evident move from 9.625 to 6.085 *not confirmed at press time.*

Turkey—TAT, 9.515, fine level in *English* to North America daily 1815-1900. (Richmond, N.Y.; England, N.H., others)

Press Time Flashes

The monthly DX session, "This Radio Age," from *Radio New Zealand* is currently aired the first Tue. of each month 0430 over ZL7, 6.080, ZL8, 9.620. (Radio Australia)

The Central Forces Radio Station, Athens, Greece, lately has returned to its old channel of 6.33 from 7.420; noted 1255. (Pearce, England) 4VEH, Cap Haitien, Haiti, has a *new* 10 kw. transmitter under construction for use in the 49- and 60-m. bands. (West, Va.) Port Moresby, Brt. New Guinea, has ceased use of VLT7, 7.280, VLT9, 9.520, and all its sessions are now aired over a *new* outlet, VLT6, 6.130. (Ballou, Calif.; Radio Australia, others) A station with news in French on 7.410A at 1800 seems to announce as *"Radio Hirondelle;"* may be Hanoi, Indo-China (Vietnam); usually has dance music (recordings) from 1815. (Pearce, England)

The German *Bundespresident,* Dr. Theodor Heuss, inaugurated the *new* (West) German Short-Wave Service recently over the 20 kw. transmitters at Norden-Osterloog; five daily 3-hour transmissions are now presented—original broadcast 1300-1600 to Africa, 11.795; tape recording rebroadcasts 1700-2000 to South America, 11.795; 2030-2330 to North America,

CRYSTALS
FOR ALL PURPOSES

LOW FREQ.-FT 241A for SSB, latice filter, ½" spc. 54th or 72nd harm channels listed by fund. Fractions omitted.

374	395	418	487	511
375	396	419	488	514
377	397	420	490	515
379	398	422	491	516
380	401	423	492	518
381	403	424	493	519
383	404	425	494	520
384	405	426	495	522
385	407	427	496	525
386	408	431	497	526
387	409	433	498	530
388	411	435	503	531
390	412	436	504	533
391	413	481	506	537
392	414	483	507	538
393	415	484	508	
394	416	485	509	

49c each. 10 for $4.50

400	464
440	466
441	468
442	470
446	472
447	474
450	475
452	476
461	477
462	479
463	480

99c ea. 10 for $9.00

SCR. 522 ⅛p ½" sp.

5910
6370
6450
6470
6497
6522
6547
6610
7350
7580
7810

$1.29 each

Add 20¢ for each 10 xtals or less for postage and handling

BC-610 2 banana plugs ¾" spc.

2030	2435
2045	2442
2105	2532
2125	2545
2145	2557
2155	3202
2220	3215
2258	3237
2280	3250
2282	3322
2290	3510
2300	3520
2305	3550
2320	3580
2360	3945
2390	3995
2415	

$1.29 ea.

FT-½" spc.

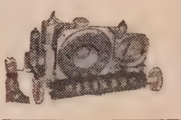
4190	6175	7773
5030	6206	7806
5485	6773	7840
6040	6873	7873
6073	6906	7906
6140	7740	7940

49c ea. 10 for $4.50

1015	5725	5840	6306	6475	6640	7506	7706
2045	5740	5850	6325	6506	6673	7540	7973
3735	5760	5873	6340	6540	6706	7573	8240
5305	5773	5906	6373	6573	6740	7606	8250
5677	5800	5940	6406	6575	7440	7640	8273
5706	5806	5973	6450	6600	7506	7650	
	5825	6273	6473	6606		7673	

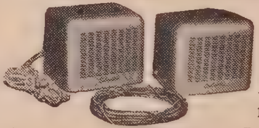
99c each 10 for $9.00

Special Purchase! FM Radio Chassis



88-108 MC—Complete with 6 tubes, built-in antenna and speaker. Product of famous radio and TV maker whose name we promised not to mention . . . . . **$16.95** Maroon plastic cabinet for above $5.95.

TWO-STATION INTERCOM SYSTEM



Consists of master and remote station, 20-ft. of 3 wire cable. 115 V operation, AC or DC. Extra wire .05 per ft. . . **$16.97**

TV CHASSIS
NOT A KIT

Complete with picture tube and speaker. 20 tubes. Standard coil high gain cascode front end.

20-INCH: $157 | **17-INCH $143**

Sun
PARTS DISTRIBUTORS, LTD.
520 TENTH ST., N.W. - WASHINGTON, D.C.

Please mention
RADIO & TELEVISION NEWS
when answering
Advertisements

RADIO ENGINEERING DEGREE IN 27 MONTHS

Radio engineering is a big field. There's room for you in it—if you're good. Get first-class training at Indiana Tech. Intensive specialized course, including strong basis in mathematics and electrical engineering, advanced radio theory and design, television, electronics. Modern laboratories. Low rate. Also **B.S. DEGREE IN 27 MONTHS** in Aeronautical, Chemical, Civil, Electrical and Mechanical Engineering. G.I. Government approved. Enter September, December, March, June. You can earn part of your expenses right here in Fort Wayne while you are studying.

INDIANA TECHNICAL COLLEGE
963 E. Washington Blvd., Fort Wayne 2, Indiana

Please send me free information on B.S. Engineering Degree in 27 months as checked.

☐ Radio-Television
☐ Civil
☐ Mechanical
☐ Aeronautical
☐ Electrical

Name ....
Address ....

90, 6.270; 0530-0830 to Far East, 15.275; 0930-1230 to ar East, 11.795. All broadcasts in German, the first 10 hutes being news followed by 5 minutes of commercial vs; remainder is musical entertainment and talk fea-es. Reports are requested to Deutsche Welle, Koeln, nkhaus N.W.D.R., Cologne, Germany.

Radio Free Asia has ceased its short-wave transmission m San Francisco, Calif., relayed by Manila, Guam, will ncentrate on use of m.w. stations in Far East and on er more direct means of communicating with Asian ples. (Winch, Calif., others)

According to officials of *Radio Thailand,* Bangkok, by s time, should have a *new* 50 kw. station on the air, K9, with three separate programs for overseas lis-ers; the existing omni-directional broadcast 0500-0625 o be continued, with addition of news and program in inese (Kuoyu dialect); two additional transmissions are be beamed to North America, Europe, at times that l not yet been decided at press time; another 10 kw. v. station is due for service in 1954. Watch for the new kw.-er on 6.24, 7.105, 11.910, or 15.630 around 0500-5. (Scheiner, N. J.)

According to announcement, *Radio Peking's* former 0400 *glish* session is now on *summer* schedule at 0300; other *glish* periods (1730, 0830) remain unchanged.

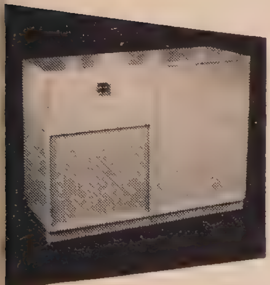
Budapest, Hungary, has moved to *summer* channel 11.91 m 6.248A; noted 1845 relaying Moscow over the 11.91 let. (Bellington, N.Y.) Noted with *English* 1930 to rth America, announcing similar broadcasts for 1715, 0 on 11.91, 7.22, 9.833. (Johnson, N.H.) Cushen, N.Z., s Suva, Fiji, is being heard now on two channels in allel—5.975, 6.100—around 0030 and later.

Marconi's Wireless Telegraph Co., Ltd., England, says 9 *new* short-wave transmitters being built for SABC, uth Africa, will be 20 kw. and will cover all of South ica; will be located at Paradys, near Bloemfontein, l frequency changing will be controlled centrally. BC officials say they hope to have one of these

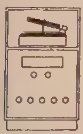
(*Continued on page* 110)

Custom-Styled for Hi-fidelity

by Cabinart



Dimensions: 35½" H., 23½" W., 18" D.
Finishes: Blond Birch, Cordovan Mahogany on Birch.
Baffle Area: 6½ cubic feet.



MODEL 28
Equipment Cabinet
72.00
net

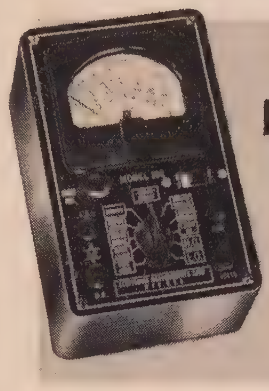
MODEL 27
Speaker Cabinet
48.00
net

Designed for the audiophile, these handsome cabinets will accommodate any combination of high fidelity components. Panels are replaceable for future changes of equipment. The loudspeaker cabinet is acoustically correct, tuned for the average 12" or 15" loudspeaker, pre-cut as requested. Construction is of select birch, with a fine lacquer finish hand-rubbed to a high gloss. All joints are glued and screwed, and lock-joint miters are used throughout, affording utmost rigidity.

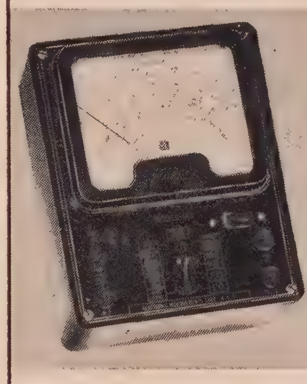
Sold through leading radio parts distributors. Write for free catalog RN-7.

& H WOOD PRODUCTS COMPANY 75 N.11th ST. BKLYN. 11, N. Y.
Pioneers in radio furniture for high fidelity equipment.

Compare... prove EMC superiority



model 102
(1000 ohms per volt meter) • 3" SQUARE METER • 3 AC CURRENT RANGES (0-30/150/600 ma.) • Same zero adjustment for both resistance ranges 0-1000 ohms, 0-1 meghoms) • 5 DC & 5 AC Voltage Ranges to 3,000 volts • Also 4 DC Current Ranges $14.90



model 103
(1000 ohms per volt meter) • 4½" SQUARE METER • 3 AC CURRENT RANGES (0-30/150/600 ma.) • Same zero adjustment for both resistance ranges (0-1000 ohms, 0-1 meghoms) • Same Ranges as Model 102 • Also 5 DB Ranges $18.75
Model 103-S with plastic carrying strap...... $19.25

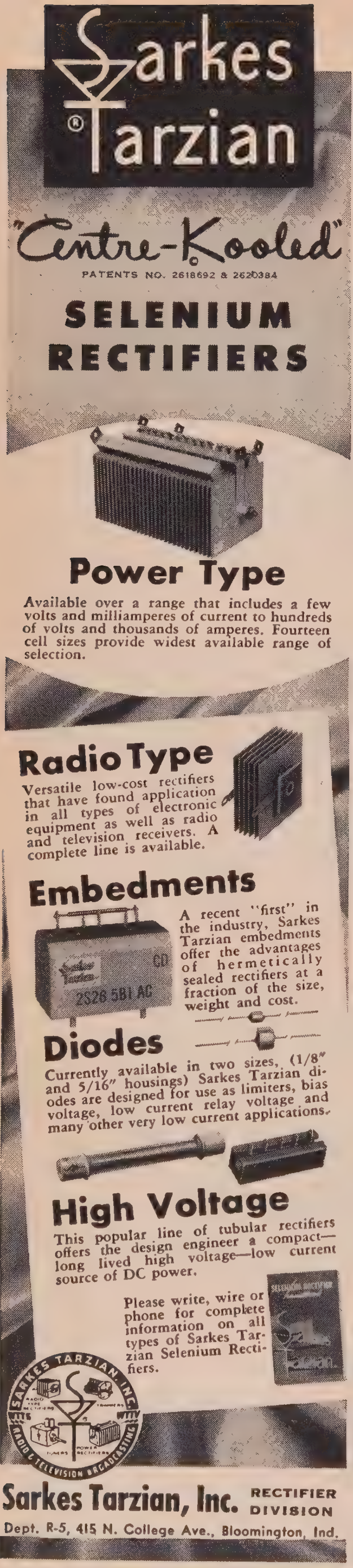
model 104
(20,000 ohms per volt meter) • 4½" SQUARE METER (50 microamperes-Alnico magnet) • Includes carrying strap • 5 DC Voltage Ranges at 20,000 ohms volt to 3,000 V.: 5 AC Voltage Ranges to 3,000 V. • 3 Resistance Ranges to 20 megs • Also 3 AC & DC Current Ranges • 5 DB Ranges $26.95
HVT 30,000 Volt Probe for Model 104 .... $7.95

—See them at your Jobbers—

EMC

Write Dept. *RN-7* for Free Complete Catalogue of these and other Instruments.

ELECTRONIC MEASUREMENTS CORPORATION
280 LAFAYETTE STREET • NEW YORK 12, N. Y.
EXPORT DEPARTMENT 136 LIBERTY STREET, N.Y.C. 6, N.Y.


Sarkes Tarzian

"Centre-Kooled"

PATENTS NO. 2618692 & 2620384

SELENIUM RECTIFIERS

Power Type

Available over a range that includes a few volts and milliamperes of current to hundreds of volts and thousands of amperes. Fourteen cell sizes provide widest available range of selection.

Radio Type

Versatile low-cost rectifiers that have found application in all types of electronic equipment as well as radio and television receivers. A complete line is available.

Embedments

A recent "first" in the industry, Sarkes Tarzian embedments offer the advantages of hermetically sealed rectifiers at a fraction of the size, weight and cost.

Diodes

Currently available in two sizes, (1/8" and 5/16" housings) Sarkes Tarzian diodes are designed for use as limiters, bias voltage, low current relay voltage and many other very low current applications.

High Voltage

This popular line of tubular rectifiers offers the design engineer a compact—long lived high voltage—low current source of DC power.

Please write, wire or phone for complete information on all types of Sarkes Tarzian Selenium Rectifiers.

Sarkes Tarzian, Inc. RECTIFIER DIVISION

Dept. R-5, 415 N. College Ave., Bloomington, Ind.

new transmitters on the air by the end of 1954, all in use by middle of 1955. (Scheiner, N. J.)

Burma plans three *new* 50 kw. short-wave transmitters to be completed in 1955, and an overseas service then for neighboring countries. (Scheiner, N. J.) By this time, *Radio Luxembourg* plans to have a *new* 50 kw. transmitter on the air to beam French sessions on 6.090 with omni-direction antenna 0040-0930, 1045-1800; current schedule on 15.350 is 0600-0800 in Flemish, and 1300-1800 on 6.090 in *English.* (Scheiner) *WRH* says *Radio Tirana,* Albania, is now broadcasting a special program on 9.700 for Albanians in USA on Sun. 1930-2000; *not confirmed at press time.*

More recently, the 0730-0740 news from *Radio Pakistan* has been noted on 17.770 instead of on (former) 17.710. (Pearce, England) *Radio Peking* lists revised schedule of 1600-1700 on 6.100, 10.260, 11.690; 1700-1730 on 6.100; 1730-1800 *English* on 11.690, 15.060; 1800-2100 on 11.690, 15.060; 0300-0330 on 6.100, 10.260; 0400-0430 *English* on 6.100, 7.500, 9.040, 10.260, 11.690, 15.060, 15.170; 0430-0700 on 11.690, 15.060; 0700-0730 on 6.100, 7.500, 9.040, 10.260, 11.690, 15.060, 15.170; 0730-1030 on 11.690, 15.060 (*English* 0830-0900A). Wrote that *will increase transmitter power* in near future. (Scheiner, N. J.) Chania, Greece, is now on 8.970, relays *Radio Athens* 0600. (Bluman, Israel, *via WRH*) More recently, Damascus, 11.913A, Syria, has had news 1645 (rather than 1715). (Pearce, England) CBFW, 6.090, Canada, has ceased operations due to opening of new BCB stations in the Western Provinces. (NNRC)

SBC, Berne, Switzerland, is now on *summer* schedule; changes include 0945-1130 to India-Pakistan (*English*) on 11.865, 17.784 (replacing 9.665); 1145-1330 to Middle East (*English*) on 11.865, 15.120 (replacing 9.665); 0600-0830 European program beamed to Africa on 17.784 (replacing 21.520); all other programs are unchanged. (*WRH*)

English newscasts from AIR, Delhi, India, are now 1930-1940, 11.850, 9.630; 2310-2320, 17.705, 15.130; 0235-0245, 17.740, 15.380; 0830-0840, 15.380, 11.850; 1045-1055, 15.290, 11.780.

"Voice of Free China," Taipeh, Taiwan, is scheduled 2300-2400 *English* to USA, 11.735, 15.235; 2300-0030 dictation news (Chinese) to China, South Seas, 670 kc., 6.095, 7.130 (from 0000 also on 11.735); 1400-1600 European program, 11.800 (*English* 1420, French 1450); 1730-2300 Chinese, Cantonese, Mandarian to Asia, 670 kc., 7.130, 11.735. (Hardwick, N.Z.) Martin, R.I., recently noted NBA, 7.820, Balboa, Canal Zone, with sports for Puerto Rico evenings (*EST*).

Acknowledgment

Thanks for FB reports; keep them coming to 948 Stewartstown Road, Morgantown, West Virginia, USA. Good DX-ing this summer!—K.R.B.

for dependable sound

INDUSTRY relies o

ATLAS

the complete line for every public address need!

DR Double-Reentran Projectors

Paging & Talk-Back Speakers

ALNICO-V-PLUS Driver Units

Dual Speakers

FULL-GRIP, VELVET-ACTION Mike Stands

DEPENDABLE QUALITY

The latest electro-acoustic researc and engineering—and over 20 year of manufacturing know-how—are be hind every ATLAS product.

DEPENDABLE SERVICE

Coast-to-coast and around the world today—in every Industrial, Marine, Railroad, Military, Educational, Civic, U.S. and Foreign Government application—under every kind of climate and noise condition — ATLAS sound equipment is famous for highest efficiency and durability. That's the proof of ATLAS performance dependability.

DEPENDABLE DELIVERY:

Yes, ATLAS gives our Government highest priority. And yes, we too feel the pinch of material shortages. But our customers will continue to get our usual dependable delivery—because we believe in equitable and dependable distribution to all ATLAS users.

DEPENDABLE PROFITS:

Completeness of line, excellence of product, dependable delivery, right prices—that's the ATLAS combination that means high, steady Industrial Sound profits for You!

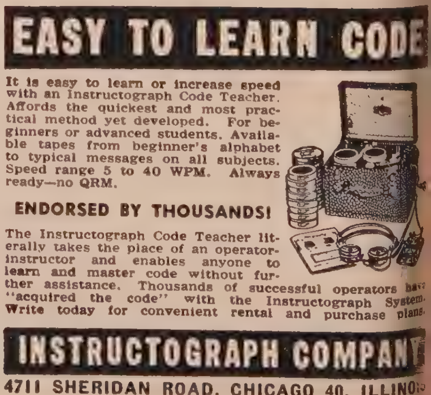
●

JUDGE for yourself, COMPARE ATLAS at your local Jobber today. See why ATLAS is the preferred line for utmost dependability. Write NOW for FREE latest Catalog 551

ATLAS SOUND CORP.

1446-39th Street, Brooklyn 18, N. Y.

In Canada: Atlas Radio Corp., Ltd., Toronto, Ont.


EASY TO LEARN CODE

It is easy to learn or increase speed with an Instructograph Code Teacher. Affords the quickest and most practical method yet developed. For beginners or advanced students. Available tapes from beginner's alphabet to typical messages on all subjects. Speed range 5 to 40 WPM. Always ready—no QRM.

ENDORSED BY THOUSANDS!

The Instructograph Code Teacher literally takes the place of an operator-instructor and enables anyone to learn and master code without further assistance. Thousands of successful operators have "acquired the code" with the Instructograph System. Write today for convenient rental and purchase plans.

INSTRUCTOGRAPH COMPAN

4711 SHERIDAN ROAD, CHICAGO 40, ILLINO

1953 RCA Receivers

(*Continued from page* 51)

system. The alignment of T_{106}, and T_{108} is simple because each nsformer is peaked for maximum ponse at one specific frequency. over-all i.f. response, including response of the input i.f. trans- ner T_{104}, should be flat with 42.50 and 45.75 mc. falling at the 70% nts on the response curve. A 47.25 tunable trap is located across the nary of T_{104} to attentuate the ad- ent channel sound carrier.

diode formed by the grid and hode of V_{109A} is used to detect the eo signal from the i.f. signal. Both sound and video signal appear oss the diode load components, and L_{104}. The 4.5 mc. sound signal eloped across L_{104} is coupled to the nd circuits. A 4.5 m.c. parallel- ed trap, L_{105} and C_{137}, prevents nd from entering the video ampli- stage.

he diode formed by the plate and hode of V_{109A} is prevented from in- cting with the picture detection holding the plate negative with re- ct to the cathode. This is done by pling negative voltages from the c. bus and the horizontal drive cuit. These voltages are filtered the components C_{134}, R_{137}, and R_{170}. frequency compensated video am- ier V_{110} is used following the pic- e detector. V_{110} employs a 6CL6 in irectly-coupled pentode circuit. The ture or contrast control is part of plate load. *RC* networks across control provide a varying degree compensation as the control setting changed. L_{107}-R_{146} and C_{171}-R_{192} give litional compensation acting in ies with the signal lead to the hode of the kinescope.

ync Separator and Output Stages

he horizontal sync separator, V_{111B}, the vertical sync separator, V_{109B}, hove sync voltages from the com- ite video signal to operate the ep circuits. Each separator stage s one-half of a 12AU7. V_{111B} is sed almost to cut-off by R_{160} in its hode circuit. R_{160} and C_{147} form an network of short time constant. a result, V_{111B} can approach cut-off idly and the plate signal will con- n the horizontal pulses and only leading edge of the vertical pulses. Vhen the composite video signal is lied to the grid of V_{109B}, the grid ws current on both the horizontal vertical sync pulses. As a result, grid develops voltage across C_{151} ich biases V_{109B} to a point near cut- The video signal lies beyond cut- and is not passed by the tube; only sync pulses are developed in the te circuit. The vertical pulses oss R_{166} are coupled through R_{165} to vertical sync output stage, V_{112A}. he bias on V_{112A} varies with changes plate voltage on the first and sec- picture i.f. amplifiers resulting

U.S.
WIRE AND
CABLE CORP.

"Rotaxial" Cables for

COMMUNITY TV SYSTEMS

Several of the largest and most successful Community TV Antenna Systems in the country, specify ***U. S. Cables.***

U. S. High Frequency Cables give you these features:

Exceedingly LOW RADIATION LOSSES, combined with consistent peak performance over the entire VHF range.

LONG LIFE and maximum efficiency, regardless of weather conditions, are inherent in these cables.

New Catalog: Write for your copy today.

UNITED STATES WIRE & CABLE CORP.

PROGRESS AND MONROE STREETS • UNION, NEW JERSEY

Representatives in Principal Cities

It's "Capitol" for Values!

WEBSTER CHICAGO CHANGER

Model 121

Automatically plays all records, all sizes, 12", 10", 7", all speeds—78, 45, and 33⅓ RPM. Simple to operate. Automatically shuts off and tone arm returns to rest after last record has been played. Minimum mounting space required, 14½" W., 13½" D., 8¼" H., with 6¼" above mounting board. Wt. 14 lbs. **$29.95**

DUAL BRIDGE RECTIFIERS

Bradley Labs. copper oxide rectifiers with the Current and Temperature Characteristics balance to less than 1%. 10.5 Volts Input max. D.C. Center leg current 15 M.A. Discs have naporized gold contact surfaces. These units are used as balance Modulators and Bridges.. **$2.25**

SPECIAL BUYS

1B3 tube sockets with ceramic stand offs and bracket............	25c
GE #1184 50 Candle power 6-8 Volts double contact base, Lamps.......	12c
456 KC. IF. transformers 1¼" square can....................	30c
1-pound of assorted radio Hardware	69c
RG-54/U Coax Cable in 10-ft. lengths	
10KP7 CRT Standard brands (Guaranteed)	$9.95
50 Assorted Micas in popular values from 10 to 10,000 mmfd.	$2.95

FILAMENT TRANSFORMER

MIL-T-27

Pri. 107.5, 112.5, 117.5, 122.5, 215, 255 and 245 Volts 50/60 Cycles. Secondary 6.3 Volts @ 5.32 Amps. and 6.3 Volts @ 3 Amps. Ceramic bushings with solder lug terminals. Rated for continuous duty under Mil-T-27, Class A Grade I Spec. Hermetically Sealed **$3.50**

MULTIPLE CONDUCTOR WIRE

22 AWG. solid twisted plastic wire 4-conductor or 2-conductor. Ideal for use in Inter-con work or speaker extensions. All wires are color coded. Comes in 100 ft. hanks only. **$1.99**
4-Conductors ....
2-Conductors 95c

RESISTOR KIT These kits contain 70-½ watt resistors, 20-1 watt and 10-2 watt resistors. All popular values, and all are American made. With absolutely no cut leads **$2.49**

THORDARSON BAND PASS FILTERS 600 Ohms to 600 Ohms, 1700 cycles to 3300 cycles. Attenuation 25 DB. at 1450 cycles or 50 DB. at 4880. Cases size 6" x 6⅝" x 5". Prices each..... **$5.00**

VARIABLE TUNING CONDENSER

Three-section gang condenser, with a worm gear drive. Which has a turn ratio of 4.5 to 180 degree rotation. Tracking section has a capacity of 162 MMFD. The other two-section have a capacity of 388 MMFD. each. Trimmers mounted on the base............... **$1.49**

Brand new 78 r.p.m. **PHONO MOTOR** without reduction, 1,000 r.p.m. **49c**

ORDER TODAY!

TERMS: 25% Deposit with order. Balance C.O.D. Include postage with parcel post orders. All prices F.O.B. Chicago and subject to change without notice. All merchandise subject to prior sale.

CAPITOL COMMODITIES CO., INC.
1229 W. WASHINGTON BLVD.
CHICAGO 7, ILLINOIS
TEL. TAYLOR 9-7393

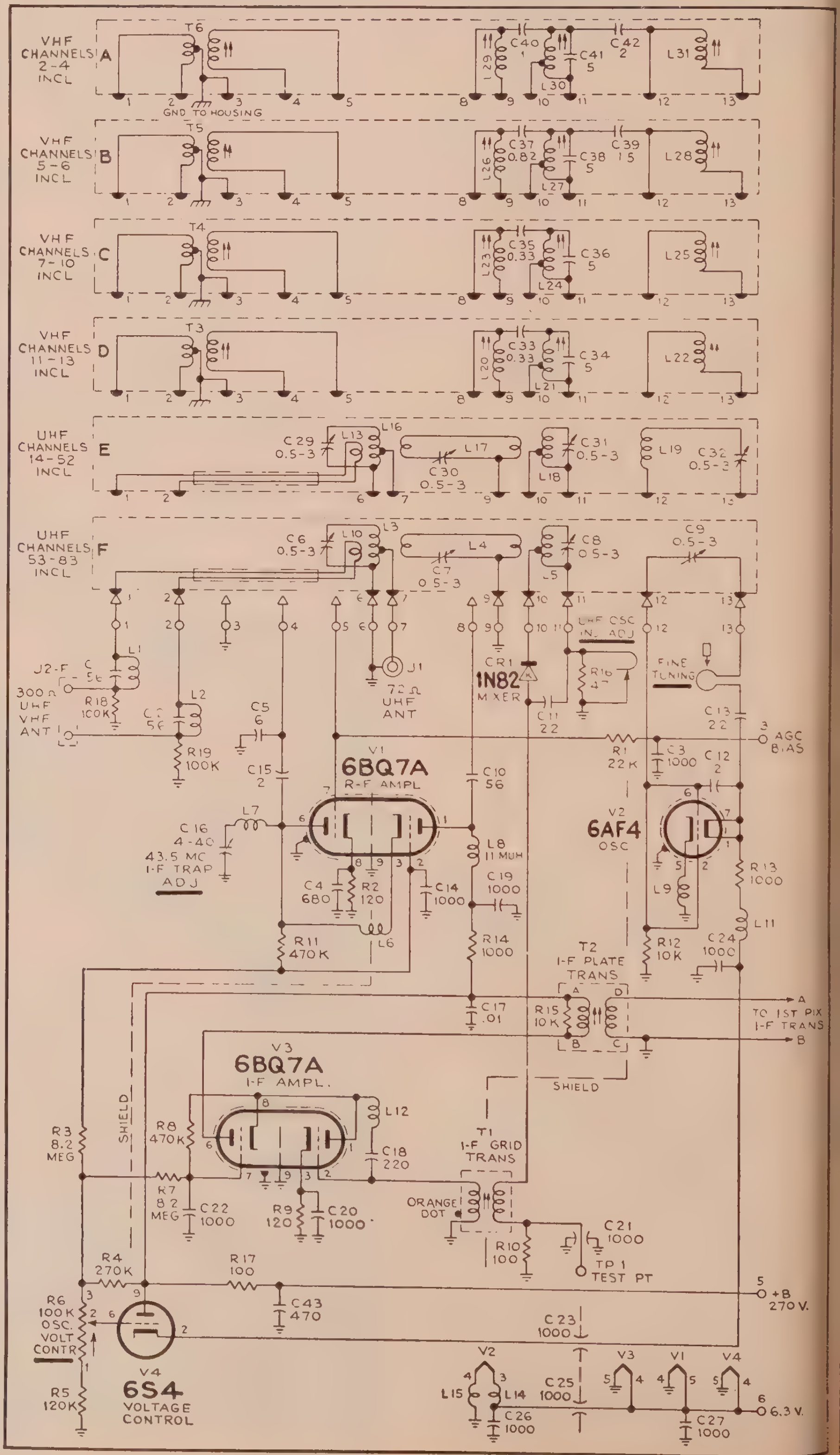
from variations in a.g.c. voltage. To effect control, the grid of V_{112A} is tied through a one megohm resistor, R_{161}, to the "B+" line which feeds the plate circuits. The result is that the peaks of the sync pulses are kept at the cut-off point of V_{112A} and all noise greater than sync level is clipped.

The vertical trigger pulses are developed by the integrating network, R_{171} and C_{155}. The horizontal pulses are coupled through the high-pass network, R_{169} and C_{154}, to the horizontal sweep circuits. In early production models, V_{112} is a 12AU7. Later production models use the type 6SN7.

Sweep Circuits

The vertical sweep oscillator V_{112B} is a feedback type of blocking oscillator circuit. The feedback loop is formed by C_{164}, R_{179}, and R_{178} from the plate circuit of the vertical sweep output to the grid of the oscillator. The ver-

Fig. 6. Complete schematic diagram of the RCA KRK-12 u.h.f.-v.h.f. tuner.



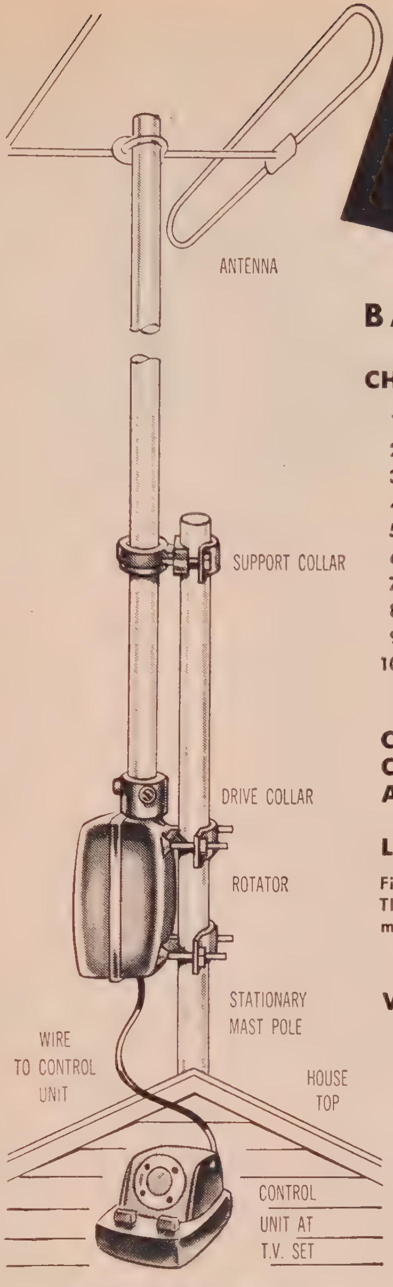
l hold control, R_{174}, acts as a fre-
ncy control for the oscillator. R_{174}
onnected into the grid return of
vertical sweep output tube, V_{113},
that momentary collapse of the
ure is prevented when R_{174} is ad-
ed rapidly. When a rapid adjust-
it is made and an increased driv-
voltage is impressed on V_{113}, a
nteracting voltage is coupled to
grid of V_{113} from the hold control.
network formed by R_{181}, R_{182}, R_{183}
C_{165} introduces feedback in the
ep output stage to improve line-
y and to reduce vertical bounce
sed by a.c. line fluctuations. The
arity control, R_{186}, is in the cathode
uit of V_{113} and varying the setting
his control varies the bias (and
ating point) on V_{113}.
he horizontal sweep and oscillator
trol circuit is a slightly modified
nchroguide" circuit. Additional
e from the horizontal oscillator
been provided by the addition of
which allows a portion of the
-tooth voltage to appear on the
llator grid. The range of the hor-
tal hold control has been extended
increasing the size of the control
n 50,000 ohms to 75,000 ohms.

A.G.C. Circuit

he a.g.c. circuit used to develop
and i.f. bias voltage is the familiar
ed type circuit. The keying pulses
taken from terminal 4 on the
n-voltage transformer and are ap-
d to the plate of the a.g.c. ampli-
V_{111A}. As a result, V_{111A} conducts
ing horizontal retrace time and
ative voltage is developed in the
e circuit. This voltage is used to
trol the gain of the r.f. amplifier
first two i.f. amplifier stages. The
ount of bias voltage produced is
trolled by the conduction through
which, in turn, is determined by
amplitude of the horizontal sync
ses applied to the grid. Sync pulses
this function are taken from the
. potentiometer which is located
he cathode circuit of the horizon-
sync separator.
delay of the r.f. a.g.c. voltage is
oduced by R_{124} and C_{125}. The posi-
voltage fed to the r.f. a.g.c. bus
ough R_{124} is overcome by the nega-
a.g.c. voltage only after the r.f.
al input has reached a level of
roximately 500 microvolts. This
y is applied because less snow will
elop on weak signal inputs when
a.g.c. voltage is applied to the r.f.
plifier stage. To prevent the r.f.
plifier grid from going positive with
voltage introduced through the
y network, the diode sections of
are tied to the r.f. a.g.c. bus.

Sound Circuits

he sound signal developed across
in the picture detector stage is
pled through two stages of sound
amplification, V_{101}, and V_{102}. In-
stage coupling of these pentode
uits is effected by a single-tuned
sformer, T_{101}, which is peaked at
mc. A ratio detector stage, V_{103}



LOOK

BIGGEST
BARGAIN IN T.V. TODAY

CHECK THESE OUTSTANDING FEATURES

1. High starting torque—no slipping.
2. 370-degree rotation—get all T.V. signals
3. Surplus power—large or small antennas.
4. Outboard bearings—relieves wind load.
5. Sturdy compact construction—7 pounds.
6. Water-proof aluminum cover.
7. Finger-tip control unit—handsome finish.
8. Thirty feet 3 circuit weather proof lead wire.
9. Signal light indicates end of 370° rotation.
10. Easily installed—complete instructions—trouble free operation. Nationally advertised.

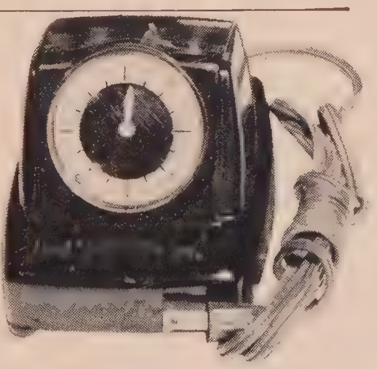
COMPLETE OUTFIT—Rotator, Bearings, Control unit and wiring at GIVE-AWAY price.

Limited Supply—Order Today!

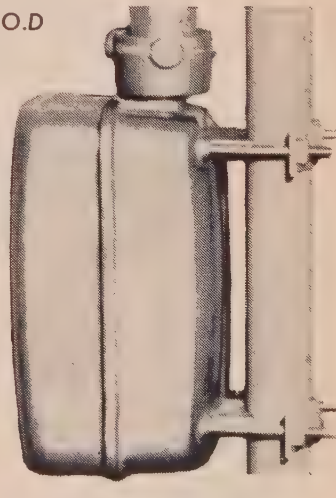
First come—first served! This is the CHANCE of a LIFE-TIME close out. You must HURRY! Get your order in the mail today. Send no money. 10 days FREE TRIAL.

WAS $39.95—NOW **\$16.95**
GUARANTEED
10 DAY FREE TRIAL

SEND NO MONEY—
WE SHIP C.O.D



Control Unit



Rotator and Bearings

ORDER TODAY • DIRECT FROM
K. W. SALES CO.
BOX 1212, TIPTON, INDIANA

HERE IT IS!

Complete, up-to-date listings, illustrations, and descrip tions of ERIE Electronic components are contained in the new ERIE CATALOG D-53.

This catalog assembles all the new items introduced since publication of our last catalog together with the long-time standard numbers.

Ask for it at your Distributors, or write Dept. B for your copy.

25th Anniversary
ERIE RESISTOR CORP. TRADE MARK

ERIE RESISTOR CORPORATION . . . ELECTRONICS DIVISION
Main Offices: **ERIE, PA.**
Sales Offices: Cliffside, N. J. • Philadelphia, Pa. • Buffalo, N. Y. • Chicago, Ill.
Detroit, Mich. • Cincinnati, Ohio • Los Angeles, Calif.
Factories: **ERIE, PA. • LONDON, ENGLAND • TORONTO, CANADA**

there must be a reason that more

QUIETROLE
TRADE MARK REG. U.S. PAT. OFF.
is being SOLD!*

More Servicemen are finding that only QUIETROLE, the original, non-conductive, non-inflammable Lubri-Cleaner will assure positive quietness to noisy TV and radio controls and switches. It does so much, yet, costs so little.

Carried by leading jobbers everywhere!

manufactured by
QUIETROLE
COMPANY
Spartanburg, South Carolina

!!POWERFUL ALNICO MAGNETS!! . . "U" TYPE for Wire or Tape Erase; Spkr. or Phones—49c 12/5.00

BAR MAGNET (¾x⅜x¼)..pol. ..ea. 39c 12/4.00

ROUND BAR (1¼x5/8O.D.)..pol. ..ea. 69c 6/3.50

ALNICO "CHIP" MAGNETS..sm. irreg. shapes. Approx. 90 pcs./oz. ....15c oz. $1.50 lb.

ALNICO MAGNET KIT...Powerful Bar, Block, "U", Rod, etc. Kit of 10 asstd. 1.98

(WRITE FOR LATEST "ALNICO" SUPPLEMENT)

AC-DC BLOWER (Delco)—approx. 25 CFM. 5400 RPM, 27-30V. Bakelite housed fan (4½x6") **7.95**

MOULDED BAKELITE CONDENSERS (Micamold) . . . 20mmf-.2mfd, 200-600V—50asstd—1.98 100 asstd. 2.98

CARBON RESISTORS..1/3-2W. 100 asstd. ... 1.98

ELECTROLYTICS.inc.multi-sect;150-450V-8asstd. 1.98

RADIO HARDWARE TREASURE..FULL LB. CAN of: Nuts, Screws, Washers, Lugs, etc..89c 3 lbs/2.49

POTENTIOMETERS.W.W.&carb.to 1meg—6 asstd. 1.49

ROTARY SELECTOR SWITCHES..incl. multi-deck. ¼" shafts. Kit of 6 asstd. 1.75

EXPERIMENTAL TUBES for Test, Research. Fil. tested. Kit of 40 asstd. rcvg. types..... 1.98

!!SUPER $$$ SAVINGS!! . . . with the New "JUMBO RADIO-ELECTRONICS PARTS KIT"... **A "GOLD-MINE"** of inventory odds & ends: **CONTROLS, SWITCHES, RESISTORS, CONDENSERS, SOCKETS, WIRE, COILS & MUCH MORE** (shpg. wt. 20 lbs.) **$3.95**

HI-FI CRYSTAL HAND MIKE—hi-imped., moulded bakelite case. 5½ ft. cable 3.95

HEADPHONES—sensitive Alnico powered. Lo-imped. Adj. forks, 5 ft. tipped cord........ 2.29

T-30 THROAT MIKE—neckband&plug..69c 10/6.50

EXT.CORD&SWITCH for T30. Less PL68.49c 10/4.50

6V. FIL. TRANSFORMER (2½x3¼), 4 amps...1.75

115V. AC ELECTROMAGNET—6 oz. pull. Cont. duty. 1" O.D.x⅞" ....ea. 98c 6/5.00

6V. AC-DC PLUNGER SOLENOID (½" O.D. x 1½"). ⅜" travel ....ea. 98c 6/5.00

G-E PLATE RELAY (CR2791-B109P36) SPDT, 10K ohm coil, 8ma. ....ea. $1.29 10/10.00

18V. DYNAMOTOR (Pioneer Gen-E-Motor SS2669). 450VDC, 50ma. Less end caps..... 3.95

1N21 CRYSTAL DIODES ......ea. 69c 10/6.50

PL54/JK26 CONNECTORS......set 39c 10/3.50

#32 P.E. MAGNET WIRE—12 oz. spool...... .98

#12 SCE MAGNET WIRE—50 ft...1.29 100ft/1.98

"KINKLESS" SUPER FLEXIBLE BRAID WIRE . . . (32/#40) WITHSTANDS CONT. BENDING & TWISTING. Cotton core; outside silk braid—20ft/98c 100ft/3.75

"DIRECT FACTORY SPEAKER REPAIRS SINCE 1927"
Min. order $3.00. 20% deposit req. on all C.O.D.'s.
Please add sufficient postage—excess refunded.

LEOTONE RADIO CORP.
67 Dey Street
New York 7, N. Y.

(a type 6AL5), follows the sound i.f. amplifiers.

A six-position function switch, S_{101}, is connected into the output of V_{103} and provides three positions of tone for both television and phonograph operation. In the phonograph position, the kinescope is disabled by removing the heater and first anode voltages. Further sound amplification is provided by V_{104} and V_{105}.

To facilitate the servicing of the KCS-82 chassis the schematic diagram (Fig. 5) includes d.c. voltage readings at tube pins and other points in the circuit. The voltage measurements are made with a v.t.v.m. with zero signal input to the receiver.

Alignment Procedure

Refer to Table 1, steps 1 through 9, for the alignment procedure for the video i.f. stages.

Steps 1 through 6 are to be followed preliminary to alignment with a sweep generator. When using the sweep generator, keep the leads as short as possible. There should not be more than one inch of unshielded lead at the end of the sweep cable. Connect the sweep ground lead to the r.f. unit outer shield. Complete the procedure below, and then go to step 7 in Table 1.

a. Set the channel selector switch to Channel 4.

b. Clip 330-ohm resistors across terminals "A" and "B" of T_{107} and T_{108}.

c. Preset condenser C_{119} to minimum capacity.

d. Insert a —5 volt bias at the junction of R_{147} and R_{148}. Set the a.g.c. control fully clockwise.

e. Connect a 180-ohm composition resistor from pin 5 of V_{106} to terminal "A" of T_{106}.

f. Couple a signal generator loosely to the oscilloscope diode probe to obtain markers.

—30—

ANSWERS TO QUIZ
(Page 68)

1. 270 volts.

2. First, there is a +135-volt line. This is obtained by a voltage-divider arrangement consisting of resistors (as distinguished from tubes). Second, there is a boost "B+" line. The value of this voltage is not given directly on the diagram but it can be approximated by noting that pin No. 10 of the picture tube has a voltage of +415 volts. The boost "B+" value is higher than this, possibly on the order of 450 to 470 volts.

3. A. 270-volt line; B. 270-volt line; C. 135-volt line; D. Boost "B+" line; E. 270-volt line; and F. No "B+" line, of course, since the ratio detector requires no "B+."

4. Horizontal sweep oscillator, vertical sweep oscillator, and picture tube.

5. No.

EDITOR'S NOTE: Our sole purpose in presenting this quiz in conjunction with a feature article is to help you in your service work. Whether or not we will continue this feature will depend on how you, the readers, react. Will you drop us a line and let us know what you think of this idea?

The Monimeter

(Continued from page 47)

method by which a small tubular "A" battery may be easily mounted. An ordinary hose clamp is centered just forward of the lower front edge of the "B" battery. Tightening the adjustable clamp screw holds the battery firmly in place.

The 22.5 volt "B" battery is held in position by a thin metal strip, ½" wide, placed at the center of the battery. Both "B" leads are guided to their terminating points on the underside of the chassis through small rubber grommets.

Note that bandset condenser, C_2, is mounted across the coil socket prongs with its adjusting screw facing outward. A ½" hole is drilled through the bottom plate opposite the screw slot and lined with a snug fitting rubber grommet. By laying the cabinet on its side, C_2 may be varied with an insulated rod. This eliminates the usual procedure of removing the front panel-chassis assembly each time an adjustment becomes necessary.

A 3½" chrome-finished carrying handle centered on the top of the cabinet and four rubber cushioning feet fastened to the bottom corners complete the unit's outward appearance.

Coil Data

Both windings are of #22 plain enameled wire, closewound, with ⅛" spacing between grid and plate coils. A 5-prong, 1¼" diameter coil form 2⅛" long provides ample winding space.

L_2 has 6 turns wound on the lower part of the coil form. L_1, occupying the upper portion of the form, consists of 30 turns, tapped at the 17th turn from the grounded end for 7.0 mc. fundamental operation. This tap may be made easily by slightly spacing the 17th turn from the 16th and 18th, drilling a small hole in the coil form directly under the tapping point, soldering a lead to the tapping point, and terminating it at the proper prong.

No "pruning" of grid turns should be necessary if these specifications are followed. Inasmuch as bandset condenser C_2 compensates for discrepancies in inductance by adding or subtracting capacity, the usual "cut and try" method is eliminated.

It is well to remember both coils must be wound in the same direction for oscillation to occur. The coil specifications of Fig. 2 should be followed closely, making certain all five coil leads are properly terminated.

Calibration

Perhaps the simplest method of calibration is to employ a receiver whose calibration is known to be accurate for the .5 mc. channel.

With the "Monimeter" turned on (Continued on page 116)

Don't Miss a One of the Exciting New

Developments in Electronics.

Keep Up Your Subscription to

RADIO & TELEVISION NEWS

Circulation Dept., 64 East Lake Street, Chicago 1, Ill.

FIRST CHANGER
Custom Engineered
for HIGH FIDELITY!

V-M 935HF Record Changer $59.95
"all the music is all you hear"

tri-o-matic®

935HF HIGH FIDELITY RECORD CHANGER

Featuring:

● Exclusive laminated turntable with precision-formed concentricity is mounted on new 3-ball thrust bearing! ● Exclusive 4-pole, 4-coil motor! ● Resonance-free aluminum die cast tone arm and two precision cast plug-in heads (less cartridges)! ● Gentle tri-o-matic spindle eliminates groove gripping record holders. Records are gently lowered to spindle shelf and flat, air-cushion dropped, silently to the turntable! ● V-M 45 Spindle included! (permits automatic play of up to 14 large center-hole records). ● Muting switch assures silent change cycle.

*Slightly higher in West.

Send for complete details on this superb instrument. PLEASE MAIL COUPON for your copy of, "Bring Concert Halls Within Your Walls."

V-M Corporation, Benton Harbor 4, Mich.
Please send illustrated folder, "Bring Concert Halls Within Your Walls," describing the V-M 935HF record changer.

Name..........

Address..........

City.......... State..........

Music Lovers and Professionals
RECOGNIZE THE INIMITABLE
Naturalness
IN SOUND REPRODUCTION
AFFORDED ONLY BY
BROOK
HIGH QUALITY
AUDIO AMPLIFIERS

Write today for complete technical data; also name of nearest dealer. Dept. RH-3

BROOK ELECTRONICS, INC.
First in the High Quality Audio Field Since 1934
34 DeHART PLACE, ELIZABETH, N. J.

and S_1 in an open position, the dial may be set at the 90-division mark. The receiver dial is then set at 3500 kc. C_2 is adjusted until the signal heard in the receiver is exactly zero beat with 3500 kc. A series of readings should be taken every 50 kc. ending with 4000 kc. The 4000 kc. reading will occur at approximately the 10-degree division mark on the "Monimeter" dial. Readings at 50 kc. intervals over the range 3500-4000 kc. represent 11 reference points. A calibration curve may now be drawn and intermediate frequencies determined by interpolation.

Operation

If the circuit and coil data of Fig. 2 have been carefully followed, no difficulty will be encountered. One should make sure that the front and rear panels are fastened securely and coil and tube remain firmly seated in their respective sockets.

S_1 in an open position allows fundamental 3.5 mc. operation by utilizing all grid coil turns. S_1, closed, furnishes fundamental operation on 7.0 mc. by shorting out approximately 56% of the coil turns. The ratio of capacity (C_1) to inductance (L_1) will determine the percentage of bandspread possible. C_2 is a major factor in "spotting" the desired channel at any pre-set dial division.

With coil specifications as outlined and an extra stator plate added to C_1, a 90-degree dial spread is obtained over the 3500-4000 kc. range. Approximately 40 dial divisions cover the 7000-7300 kc. band.

All frequency measurements should be made with S_1 open. Thus, the 3.5 mc. range is checked using the fundamental while 7.0 mc. readings employ the second harmonic.

Although specifically designed to cover only these two ranges, it is possible to check the 14-mc. and 28-mc. spectrum by employing harmonics of a higher order.

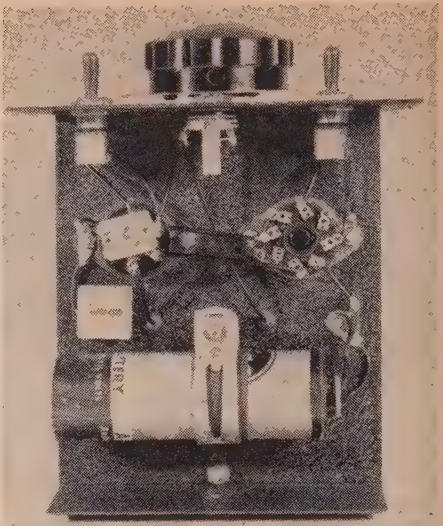


Fig. 3. Under-chassis view of "Monimeter." A glance shows the small investment in time and money for this operating convenience.

Conclusion

With stabilized, self-excited oscillators daily replacing or augmenting crystal-controlled units, a combination monitor-frequency meter will be found indispensable.

Properly constructed and calibrated, accurate frequency measurements may be made and one's signal critically examined. Familiarity with the "Monimeter" will suggest uses other than routine monitoring and frequency spotting.

As an additional construction incentive it would be well to remember that this station accessory never becomes obsolete. It will be found equally valuable whether one boasts a transmitted power input of a kilowatt or the smallest fraction thereof. —30—

TV set shipments to dealers by states for period 1946-1952 as reported by RTMA.

STATE	TOTAL	STATE	TOTAL
Alabama	156,268	Nebraska	139,479
Arizona	49,948	Nevada	581
Arkansas	36,893	New Hampshire	63,570
California	2,097,472	New Jersey	1,282,586
Colorado	100,571	New Mexico	20,406
Connecticut	445,902	New York	3,505,155
Delaware	77,200	North Carolina	255,067
District of Columbia	251,054	North Dakota	1380
Florida	200,495	Ohio	1,855,765
Georgia	279,827	Oklahoma	195,962
Idaho	2315	Oregon	46,872
Illinois	1,621,753	Pennsylvania	2,098,227
Indiana	582,977	Rhode Island	178,126
Iowa	247,251	South Carolina	59,907
Kansas	86,395	South Dakota	3673
Kentucky	242,375	Tennessee	194,736
Louisiana	141,818	Texas	607,640
Maine	22,769	Utah	89,691
Maryland	466,881	Vermont	13,787
Massachusetts	1,061,436	Virginia	305,390
Michigan	1,121,839	Washington	220,367
Minnesota	301,055	West Virginia	126,768
Mississippi	39,669	Wisconsin	359,147
Missouri	549,597	Wyoming	3065
Montana	1156		
		GRAND TOTAL	21,812,263

Mac's Service Shop

(*Continued from page 63*)

d.c. across the probes, and checked the condenser. Instantly a roaring grinding sound issued from the tracer speaker, indicating that the condenser was permitting surges of current to pass through it.

"Oh don't look so smug!" Barney exclaimed as he reached for the diagonal cutters. "How can this little condenser in the oscillator section cause that a.v.c. trouble?"

"If you would do more service manual thumbing and less test prod fumbling, as I keep trying to get you to do, you would know," Mac replied. "In this set the grid-leak of the oscillator section of the mixer tube returns to "B-minus" in the usual way, but the r.f. from the grid goes through that defective mica condenser and then through an oscillator coil winding to the a.v.c. bus. Now do you begin to see?"

"I think so," Barney said slowly. "The voltage developed on the oscillator grid across the grid-leak is fed through the partially-shorted condenser to the a.v.c. bus and so keeps the voltage there jacked up above normal, and that cuts down on the sensitivity of the set. On the other hand, when a strong station is being received, the high a.v.c. voltage that would normally be developed is shorted out partially through the low resistance path of the leaky condenser and the oscillator grid-leak. That allows the tubes to overload with the strong signal and produces the distortion. Check?"

"Check and double check!" Mac congratulated. "That's precisely the way t works. I'm beginning to believe there is hope for you after all."

"Gee, thanks!" Barney remarked wryly. —30—

SERVICE ACTIVITIES

THE Pennsylvania State Federation (FRSAP) at its April meeting went on record as endorsing the proposed Pennsylvania Licensing Bills HB-838 and HB-839 as a step toward correcting the lls in the servicing industry.

The group, representing affiliated hapters in Philadelphia, Chester, York, Williamsport, Pittsburgh, Altoona, Holidaysburg, Scranton, Wilkes-Barre, and Harrisburg, also passed a resolution "condemning RTMA and NEDA for aleged opposition to the will of organized adio-TV technicians and service dealers n Pennsylvania."

THE National Electronic Technician and Service Dealers Assn. (NETSDA) lected a new slate of officers at its threeay Eastern Conference held in Pateron, N. J.

Steps were taken to obtain a charter f incorporation for the national group.

Newly elected officers include: Roger . Haines, president; David Van Nest, ice-president; John Wheaton, correponding secretary; O. Capitelli, recordng secretary; T. L. Clarkson, treasurer, Milan J. Krupa, sergeant-at-arms. Ofces and headquarters are at 165 E. roadway, New York. —30—

AT LAST! A Way to Check Flyback & Yoke Accurately... FAST!

NEW Lako "Q"-Tester

only $69.50 Model 400-A

MONEY-BACK GUARANTEE

Test flybacks, yokes, width coils, and linearity coils right in the set! And do it in minutes instead of hours! This sensational new Lako "Q"-Tester is today's greatest development in TV servicing . . . detects one shorted turn in a thousand . . . saves hours of wasted labor. Just one quick test shows comparative rating, tells whether part is good or bad. Ready to use, 110 v A.C., complete instructions included, 90-day factory warranty.

ORDER NOW . . . MONEY-BACK GUARANTEE! Full purchase price refunded if you are not fully satisfied within 10 days!

CLIP HERE . . . write name, address in margin . . . enclose check . . . mail to:

Lako

LAKO COMPANY
ELECTRONICS DIVISION
516 EAST TOWNSEND ST.
MILWAUKEE 12, WISCONSIN

SCHEMATICS—CONVERSIONS FOR SURPLUS GEAR

NEW LIST! MANY ADDITIONS!

Send stamped, self addressed envelope for List C. Add 25c for chart explaining AN nomenclature.

R. E. GOODHEART
BOX 1220
BEVERLY HILLS, CAL.

GIFT...

from America's most advanced Hi-Fi studios . . . Come in or write for your copy of "Sound Advice" by Irving Greene, 124 pages of vital Hi-Fi data . . . It's FREE!

ASCO SOUND CORPORATION
115 WEST 45th STREET, NEW YORK 36

ANOTHER OUTSTANDING JOBBER
RADIO PRODUCTS SALES CO.
1237 - 16th St.
Denver 2, Colorado

HAS THE SENSATIONAL NEW EICO 470-K 7" SCOPE KIT IN STOCK!

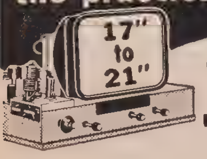
$79.95

Let me show you how EASY it is to

LEARN TV

the practical way--

D. Gnessin, Educational Director



ASSEMBLE A TRANSVISION TV KIT

Pay as You Wire $39 Down Payment

I WILL HELP YOU to start learning TV the *practical way* — by assembling a TRANSVISION TV KIT in EASY STAGES. For only $39 you get PACKAGE #1 (standard first pkg. for all of our kits). This package gives you the BASIC CHASSIS and over 450 TV COMPONENTS with complete *Instructions, Drawings, Photos, Service Booklet,* and a year's subscription to my *"TV and Electronics Notes".* When ready, you order the *next* stage (pkg. #2), etc. Low prices make your complete kit a terrific buy!

FREE CATALOG

Shows 6 Great TV Kits:

EXCLUSIVE: Only Transvision TV Kits are adaptable to UHF. Ideal for FRINGE AREAS. No Previous Technical Knowledge required. Write now!

TRANSVISION, INC., Dept. RN7
NEW ROCHELLE, N. Y.

MAIL THIS COUPON TODAY

Mr. D. Gnessin, Educational Director
TRANSVISION, INC., NEW ROCHELLE, N. Y. Dept. RN7

☐ I'm enclosing $________ deposit. Send standard kit PACKAGE #1, with all instruction Material. Balance C.O.D.

☐ Send FREE copy of your new TV Kit Catalog.

Name________________

Address________________

City__________ State__________

Tremendous Opportunities in COIN TV and COMMERCIAL TV

TRANSVISION offers the only specially designed line of **Coin-Operated** and **Commercial TV** with the

PREVIEWER* ATTACHMENT

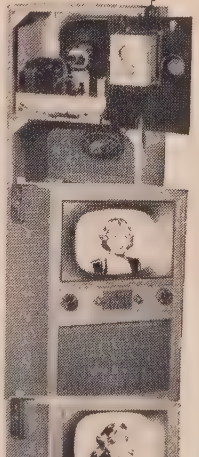
(Pat. Pend.)

This field offers rich rewards to enterprising servicemen or dealers — on part time or full time basis.

***The Electronic Previewer** is a patented device which makes coin operation really pay off in a big way. Boosts revenue by "sampling" — by giving a short *preview* of TV programs to prospective customers. Works like magic in enticing sales.

Get details now.

TRANSVISION, INC.
NEW ROCHELLE, N. Y.



MAIL THIS COUPON TODAY

TRANSVISION. INC., NEW ROCHELLE, N. Y. Dept. RN7

☐ Rush full details on COIN OPERATED TV.

Name________________

Address________________

City__________ State__________

SERVICE HINTS ON RCA TV SETS

630TS SERIES

Foldover at right-hand side of picture.

This may be caused by a reduction in bias on the grid of the 6BG6 horizontal output tube. The grid resistor (R_{205}) should be in the vicinity of 470,000 ohms. Replace if defective.

7T103 SERIES

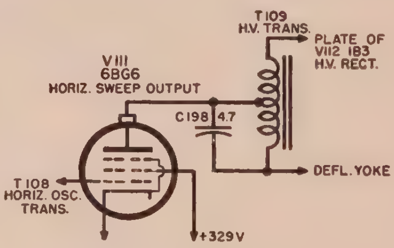
Loss of sync and intermittent loss of high voltage.

This may be caused by a shorted or open damper tube (V_{113}, 6W4) heater winding in the power transformer. To check, use a 6-volt filament transformer instead of the damper tube winding. If this cures the trouble, remove the power transformer (T_{110}, *RCA* stock part #75508) and replace it.

9T57, 9T77, & 9T79 SERIES

Narrow vertical bars on left-hand side of raster.

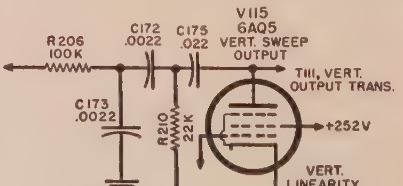
This may result from internal corona or arcing within condenser C_{198} (4.7 μμfd.) in the plate circuit of V_{111} (the 6BG6 horizontal sweep output tube). See accompanying diagram. (This interference is similar to that caused by Barkhausen oscillations, and the normal preventative steps for such oscillations should be tried first, *i.e.*, placing a magnet over the 6BG6, adjusting the drive, replacing the 6BG6, etc. If these are not effective, replace condenser C_{198}.)



17T153 SERIES

Vertical roll.

When the vertical hold control needs to be reset during the initial warm-up period and is operated at the extreme clockwise position of its rotation, it indicates that condenser C_{172} (see diagram) has changed value with time and temperature. This condenser shoul measure .0022 μfd. If faulty, replace it with a 1000 v. oil-impregnated tubular paper condenser.



17T153 & 21T176 SERIES

Snowy picture.

Improper r.f. and i.f. bias may cause snow in the picture in medium field strength areas. This may be accompanied at times by extremely dark picture with strong signals.

The cause of improper bias may be leaky condensers in the a.g.c circuit. To correct this, do the following:

1. Check electrolytic condensers C_{124} (2 μfd.) and C_{138} (2 μfd.).
2. When replacing either of these condensers, make certain that you observe the proper polarity since these are electrolytics.

21T159, 21T165, 21T176, 21T177, 21T178, & 21T179

Foldover or white bar in center of raster.

This may be due to low screen voltage on 6CD6, the horizontal sweep output tube (V_{117}). Check the screen resistors R_{253} (8200 ohms) and R_{235} (8200 ohms). These may be open; replace if necessary.

Low brilliance and small picture.

This may be caused by a partially shorted width control coil. Check coil L_{106}, and replace with *RCA* stock part #76484 if defective.

Poor interlace.

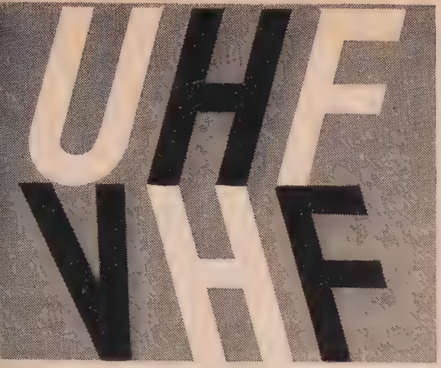
This may be caused by coupling between the vertical and horizontal sweep circuits due to incorrect lead dress. To correct this do the following:

1. Dress the red lead from th yoke socket to the high-voltage transformer under th lance on the side of the high voltage cage.
2. Connect condenser C_{185} (.04 μfd.) from pin 2 of V_{116} (6SN horizontal sweep oscillator) t ground, instead of from th nearby terminal board t ground.

CHASSIS KCS68

Vertical sync instability.

This may be caused by reflecte signals which reach the receive out-of-phase with the direct signal from the TV station. Th following changes are recommended in the sync separato stage to increase the vertica sync stability. See diagram. Thes changes will make the receive slightly more sensitive to nois on weak signals.



double purpose for double sales!

JFD Lightning Arrester AT103 protects UHF and VHF signals

For use with UHF or VHF tubular twin lead, the AT103 is the perfect tie-in for *every* antenna sale. And the exclusive JFD strain-relief lips that prevent contact washers from ripping the twin lead apart give you yet another sales-making feature. Write for bulletin #139. ***No. AT103 $2.25, list.**

*Complete with stainless steel strap and aluminum ground wire.

JFD Manufacturing Co., Inc., Brooklyn 4, N. Y.
World's largest manufacturer of television antennas and accessories

New Guaranteed TUBES Standard Brands

OA2	$1.00
OA3/VR75	1.10
OB2	1.40
OC3/VR105	1.00
OD3/VR150	.90
1A3	1.00
1B23	8.95
1B24	9.50
1B27	12.50
1N21B	2.50
1N22	1.25
1N23	1.25
1N23A	2.25
1N23B	3.25
1N34A	.79
1N38	1.50
1N58A	1.25
1N63	2.15
1N69	.89
2AS15	4.25
2C39	19.95
2C40	7.25
2C42	19.95
2C43	12.50
2C44	1.19
2C46	19.95
2C51	4.50
2C52	4.95
2D21	1.35
2D21W	2.49
2E22	1.95
2K22	32.50
2K25	28.50
2K26	69.50
2K28	27.50
2K29	23.95
2K39	110.00
2K41	110.00
2K45	110.00
2K48	99.50
3A4	.75
3A5	1.25
3B23	4.95
3B24	4.75
3B24W	7.50
3B26	3.50
3B28	7.50
3BP1	4.95
3C22	72.50
3C23	9.95
3C24/24G	1.50
3C33	9.95
3C45	14.95
3DP1	3.95
3E29	11.95
3FP7	1.95
3GP1	3.95
3HP7	3.95
3K23	299.50
3K30	299.50
4B24	6.95
4C35	22.00
4-65A	17.50
4-125A	25.00
4X150A	22.50
4X500A	85.00
5BP1	4.50
5CP1	4.95
5C22	37.50
5D21	18.50
5FP7	1.95
5R4GY	1.40
6AL5W	1.75
6AN5	2.90
6AS6	2.30
6BL6	99.50
6BM6	99.50
6F4	4.50
6I4	5.95
6K4	3.50

WE PAY HIGHEST PRICES FOR YOUR SURPLUS!

15E	1.75
15R	.89
FG17	3.95
FG32	12.95
FG57	14.95
FG95	22.00
FG104	24.50
VT-127A	2.95
100TH	9.50
250TH	16.50
304TH	7.95
304TL	7.95
307A/RK75	4.25
310A	4.95
350B	3.95
393A	8.95
394A	3.95
417A	8.50
446A	1.19
703A	4.50
705A	1.50
707B	14.95
715B	8.95

Vacuum Capacitors

50-15	$5.95
50-32	12.50
12-32	10.00
100-20	14.50

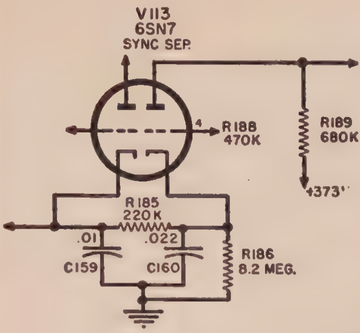
717A	.90
722A	1.95
723A/B	16.95
724A	2.95
724B	2.75
726A	12.50
726B	45.00
801A	.39
804	10.95
805	3.25
807	1.65
807W	9.95
809	2.95
811	2.90
813	11.95
814	2.95
828	9.95
829	8.95
829B	9.95
830B	2.75
832A	9.95
836	3.45
837	1.45
849	29.50
851	39.50
852	19.95
860	4.50
861	19.95
866A	1.50
872A	3.25
884	1.40
931A	5.50
954	.33
955	.49
958A	.69
959	2.45
1005	.69
1616	.90
1624	1.45
1625	.39
1626	.39
2050	1.40
2051	1.10
5635	8.95
5637	6.50
5638	8.50
5645	8.95
5646	8.95
5651	2.75
5654	2.00
5670	4.30
5672	1.20
5676	1.65
5686	4.25
5687	4.25
5694	2.60
5702	3.50
5704	2.25
5718	8.95
5719	8.95
5726	2.00
5744	1.95
5749	2.25
5814	2.50
5844	4.50
8012	1.95
8005	4.95
8025A	4.95
9001	1.25
9002	.98
9003	1.50
RK60/1641	1.95

Complete line of Receiving Tubes. Thousands of other types of Transmitting Tubes. If you don't see it, WRITE. Prices subject to change without notice. Californians add sales tax. Add postage to order.

JSH SALES CO.

ELECTRONICS
Dept. R-23
7552 Melrose Ave.
Los Angeles 46,
California

1. Change resistor R_{185} (220,000 ohms) to 1 meg., ½ w., ±10%.
2. Change resistor R_{186} (8.2 meg.) to 3.9 meg., ½ w., ±10%.



3. Change resistor R_{189} (680,000 ohms) to 22,000 ohms, ½ w., ±10%.
4. Change condenser C_{100} (.022 μfd.) to .056 μfd., 400 v.
5. Add a 100-μμfd. condenser from pin 4 of V_{113} (6SN7 sync separator) to ground.

ALL SETS

Erratic station tuning.

When TV station tuning varies, depending on the direction of approach of the channel selector switch, it indicates that there is variation in inductance during the switch operation. This may be the result of loose wafer switch contacts which cause the compression and expansion of the coils mounted on the switch when tuning. The loose contacts may result from excessive heat, applied during soldering, melting the wax on the wafer and loosening the switch terminals on which the inductances are mounted. When repairing r.f. units, care should be exercised not to overheat the oscillator switch wafer as this will cause the damage described.

Repair by replacing the wafer.

ALL SETS

High-voltage arc at picture tube.

This condition may occur in humid weather when there is a collection of dust and moisture around the bell of metal cone picture tubes. The following procedure will eliminate this trouble:

1. Remove the entire coating on the glass bell using methanol or acetone.
2. Wash the glass bell thoroughly with a good detergent.
3. Dry the glass bell thoroughly.
4. Apply a good coating of *Johnson's* "Car-Plate." Allow to dry, then wipe off the white residue.

ALL SETS USING 17CP4, 17QP4, & 21AP4 PICTURE TUBES

Poor focus.

Poor focus in these sets may be due to magnetization of parts of the picture tube electron gun. To demagnetize these tubes, connect an electromagnetic focus coil to

Now . . . INSURE BEST RECEPTION
with the
FINEST TV CHASSIS EVER DESIGNED
TRANSVISION
630 ***De Luxe*** **TYPE TV CHASSIS**
with High-Fidelity Sound
Mfr. licensed under RCA patents

Embodies the latest and finest improvements, notably:

- **Super Fringe Area Circuit**
- **Redesigned for Peak UHF Performance**
- **Hi-Fidelity Push-Pull Audio (40-13,000 Cycles)**
- **12" Hi-Fidelity Speaker**

$139
net
Plus 10% Fed. Tax
CRT EXTRA

In this space we can mention only a few of the other great features of this DeLuxe Chassis: **31 tubes** (28 tubes, 3 rectifier tubes—plus CRT makes 32 tubes) . . . Only **Sprague "Black Beauty"** Molded Condensers used throughout . . . **Allen Bradley** and **IRC RESISTORS** . . . Handles **up to 24"** picture tube . . . Layout of most efficient type for ease of servicing . . . **Carries standard RMA Guarantee** . . . The choice of those who want the finest in chasses.

CABINETS: For details on Transvision's famous beautiful line of TV Cabinets, write for information on Agent's Program.

1 YEAR GUARANTEE ON CRTs

17" Rectangular Glass CRT	net $22.25
20" Rectangular Glass CRT	net $31.95
21" Rectangular Glass CRT	net $36.95

Order direct from factory:

TRANSVISION INC., New Rochelle, N. Y.

FREE: Sample copy of "TV and Electronics Notes." Or send 50c for year's subscription.

MONEY-BACK GUARANTEE:

10-DAY TRIAL: Buy and try the Transvision 630 Type De Luxe Chassis for 10 days. Then, if you wish, you may return it. Your purchase price less 10% (our cost of handling and re-packing) will be promptly refunded.

Ask for FREE Circuit and Technical Data

TRANSVISION, INC.
DEPT. RN-630 NEW ROCHELLE, N. Y.
( ) Send me 630 Circuit and Technical Data.
( ) Enclosed find $______deposit. Balance C.O.D. Ship______chasses. ______CRTs.
( ) Enclosed find $______in full.
I accept your 10 Day Trial terms.
Name______
Address______
City______State______

PE-101C DYNAMOTOR

6 or 12 Volt

(Reprints of original CQ conversion articles — Oct. and Dec., 1952 issues, furnished.)

● This is the Dynamotor the Hams have been talking about! Easily adapted to supply 625 V. @ 150 MA. and 325 V. 125 MA. at 12 Volts—or 300 V. 90 MA. and 160 V. 110 MA. at 6 Volts. (Illustration shows modified.) NEW: $4.95

TELEPHONE WIRE

3 Conductor, copper & steel, 525 ft. $4.75

ANTENNA EQUIPMENT

MAST BASES—INSULATED:

MP-132 BASE—Illustrated at left—1" heavy coil spring, 2" insulator. Overall length: 11½." Weight: 2¾ lbs. Price $3.95

MP-S-33 BASE—Insulated type with heavy coil spring and 5" dia. insulator. Requires 2" hole for mounting. Weight: 9 lbs. $5.95

MAST SECTIONS FOR ABOVE BASES

Tubular steel, copper coated, painted, in 3 ft. sections, screw-in type. MS-53 can be used to make any length with MS-52-51-50-49 for taper. Any section..............................50c Each
Larger Diameter Section: MS-54..................$1.25

DYNAMOTORS

DYNAMOTOR and BLOWER: 9 Volts DC input; output 450 Volts 60 MA. 4500 RPM. At 6 Volts DC input; output 260 Volts 65 MA. 3000 RPM. Price.................................... **$4.95**

INPUT:	OUTPUT:	STOCK No.:	PRICE:
12 V.DC.	220 V. 70 MA.	DM-24	$ 6.95
14 V.DC.	330 V. 135 MA.	DM-330	7.95
14 V.DC.	500 V. 500 MA.	PE-59	14.95
12 V.DC.	250 V. 50 MA.	DM-25	8.95
12 or 24 V.DC.	500 V. 50 MA.	USA/0515	3.95

TRANSFORMERS—110 V. 60 CYCLE PRIMARIES:
5 Volt CT-25A—10,000 V. Ins. OPEN FRAME—6" x 5" x 4½"..............................$7.95
6.3 V. 1 Amp.....1.25
24 V. 1 Amp..... 1.95
24 V. ½ Amp.....1.50
24 V. 6.5 Amp..... 5.95
6—24—or 30 Volt 8 Amp.............................. 5.95

RECEIVER AND TRANSMITTER

RECEIVER BC-229 or 429—TRF Receiver with 3 Plug-in Coils to cover Freq. Range 201 to 398, 2500—4700, 4150—7700 KC. With 6 Tubes: 1/37—1/38—3/39. Power Supply required, 6 or 12 Volt & 250 Volts. Size: 16"x8"x7". Schematic included.............................. **$8.95**

TRANSMITTER BC-230—Voice modulated Trans. with 5 Plug-in Coils to cover Freq. Range 2500 to 7700 KC. With 4 Tubes: 2/10y—2/45 & RF Meter 0-1.5 Amps. Power Supply required, 6 or 12 Volt & 350 Volts. Size: 13"x8"x7". Schematic included.............................. **$8.95**

SPECIAL BUY—BOTH RECEIVER AND TRANSMITTER $15.00

BLOWERS—115 VAC 60 CYCLE

SINGLE TYPE: (Illustrated at left) 100 CFM. 2¼" intake: 2" outlet. Complete size: 5" x 6". Order No. 1C939.........$8.95

DUAL TYPE: 100 CFM. 4" intake; 2" Dis. Each Side. Complete Size: 8" x 6". Order No. 1C880....................$13.95

COMPACT TYPE: 108 CFM. Motor built inside squirrel cage, 4½" intake; 3⅜" x 3" Dis. Complete size: 4¼" W x 8⅜" H x 8⅛" D. Order No. 2C067 ....$14.50

FLANGE TYPE: 140 CFM. 3½" intake; 2½" Dis. Complete size: 7½" W x 7¼" H x 6¾" D. Order No. 1C807 ....$13.95

FLANGE TWIN: 275 CFM, 4½" intake; 3¼" x 3" Dis. Complete size: 11¾" W x 8⅜" H x 8-1/16" D. Order No. 2C069 ....$21.95

POWER SUPPLIES

VIBRATOR TYPE—6 Volt DC input; output 230 Volt DC 50 MA.—not filtered—w/tube. Ideal for Command Receiver operation as receiver is filtered internally. Size: 4½" x 4¼" x 3½"........................$5.95

BATTERY SWITCHING UNIT and METER Used to switch load from one battery to another—or 6 to 12 Volts. Contains Weston 2" Meter—0-15 Volt DC Scale for reading battery voltage. 20 Amp DPDT Switch and Indicator. Case size: 4" x 6¼" x 2¾"..............................NEW: $2.95

Address Dept. RN • Minimum Order $5.00 • Prices F.O.B., Lima, O. • 25% Deposit on C.O.D. Orders

FAIR RADIO SALES
132 SOUTH MAIN ST.
LIMA, OHIO

RADIO ANTENNA

Center Loaded

The Original Designed by Premax for

MOBILE RIGS

The Antenna that gives better signal and reception, enabling you to cover greater distances.

Available for 10 to 75 meters, with special coils for C.A.P., Airport, Civil Defense and Marine.

Send today for Bulletin and prices of Premax Mobile Antennas and Mountings.

PREMAX PRODUCTS
DIVISION CHISHOLM-RYDER CO., INC.
5304 HIGHLAND AVE., NIAGARA FALLS, N. Y.

!!WANTED!!

In order to supply government and industrial requirements, we are paying top dollar for all types of radio and electronic surplus. We specialize in test equipment and complete radios, such as:

APA, APN, APQ, APR, APS, APT, ARB, ARC, ARN, ART, ATC, BC, DY, I, IE, LM, MG, PE, PU, SCR, TCS, TN, TS, and many others.

WE ESPECIALLY NEED: APA10, APN9, APR4, APS4, ARC1, ARC3, ART13, ATC, BC221, BC342, BC348, BC611, BC721, DY12, DY17, 1100, LM10 to LM18, MG149F, MG149H, PU14, R5/ARN7, R5A/ARN7, SCR718C, TCS, TN16, TN17, TN18, TN19, TN54, TS3, TS13/AP, TS33, TS35, TS45, TS75, TS76, TS102, TS147/UP, TS148/UP, TS173, TS174, TS175, TS250, TS251, TS323, (1CT, 1F, 1G, 5CT, 5DG, 5F, 5G, 6DG, 6G 115V. 60 c.p.s. Selsyns), and all types of Hewlett Packard, General Radio Co., Measurements Corp., Boonton Radio, Ferris, Leeds & Northrup, and other test equipment.

Please state accurate description, condition, and your lowest price. Explain modifications, if any. We pay freight charges.

PURCHASING AGENTS, ENGINEERS, EXPORTERS, INDUSTRIAL BUYERS, DEALERS, AND INDIVIDUALS, Please send us your requirements.

New Catalog Now Available

PHOTOCON SALES
417 N. Foothill Blvd.
Pasadena 8, California
SYcamore 2-4131
RYan 1-6751

117 volts a.c. and pass the coil slowly over the neck of the picture tube past the electron gun, and then slowly withdraw it. If such a coil is not available, any electromagnetic coil capable of withstanding 117 volts a.c. may be used. —30—

UNUSUAL TV TROUBLE

By RICHARD BLITZER

Tele-Video Associates

THE television technician can usually determine, by observing sound, picture, and raster, just what circuit is to blame for faulty receiver operation. However, every now and then a difficulty arises which results in very peculiar symptoms being exhibited in seemingly independent circuits. Here is one that the writer encountered recently.

The symptom: Sound perfectly normal, picture present but out of sync horizontally and vertically. This particular set was a Crosley Model 9-407, but the circuit, as shown in Fig. 1, is common to many other sets.

All suspected tubes associated with the sync section were replaced without success. An oscilloscope showed good video signal at the plate of the video amplifier, as indicated on the schematic diagram, and also at the cathode of the d.c. restorer tube (D.C.R. on the diagram). No sync pulses were observed at the plate of the D.C.R. tube. An ohmmeter indicated that R_1 was normal and C_1 not shorted.

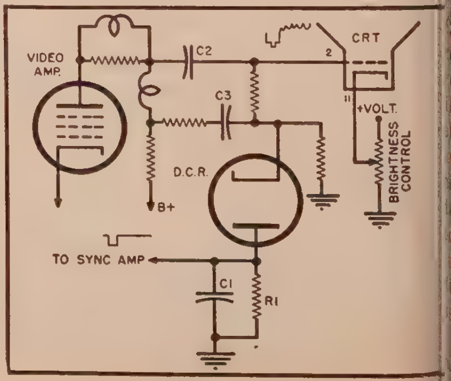
A d.c. voltmeter showed that the cathode of the d.c. restorer tube was +50 volts. Condensers C_2 and C_3 were checked on the ohmmeter but exhibited no symptoms of shorts or leakages. As an additional check, the voltage on the cathode of the d.c. restorer tube was measured while C_2 and C_3 were disconnected. The cathode still had +50 volts on it.

The only source of the positive voltage to the d.c. restorer cathode was the grid of the picture tube. With the CRT's base plug disconnected, the ohmmeter read 500,000 ohms between base pins 2 and 11, the grid and cathode.

This leakage between the grid and cathode of the picture tube allowed the positive d.c. voltage of the brightness control to reach the d.c. restorer cathode. The d.c. restorer stage was thus biased with a positive cathode and could not conduct. As a result, no sync pulses were permitted to leave the d.c. restorer stage and reach the horizontal and vertical circuits.

Replacing the picture tube cured the trouble completely. —30—

Fig. 1. Partial schematic of Crosley 9-407.



10-Meter Mobile for CD

(*Continued from page* 53)

ase pin 8 of the power plug can be grounded. The metering jack, J_2, vhich is insulated from the chassis in his transmitter, might not have to e insulated with some other power-upply arrangement.

The shape and size of the chassis ase are determined mainly by the ize of the larger components and the vailable space in the car. The chasis shown measures 4″ x 7½″ x 1½″ nd was home-made from a piece of crap aluminum. No dust cover was nade because the unit was mounted t the back of the glove compartment.

The initial adjustments and tests re made with an a.c.-operated, 150-volt power supply. Connect the transnitter power plug to the power suply as follows: pins 1 and 8 to ground, in 2 to 6.3 volts (with the other side f the 6.3-volt output grounded), and in 3 to "B-plus." Wedge the relay ontacts shut with toothpicks (as they vill not close on a.c.) and turn on he power. Connect a v.t.v.m. in series vith an r.f. choke to the grid of the V6GT doubler-final and tune the osillator trimmer, C_1, for a maximum ndication, which should be about —45 olts. Then, for maximum dependaility, shift C_1 slightly toward the igh-frequency side of resonance. Next, plug a 0-1 ma. meter into J_2 nd adjust C_5 for a minimum indicaon which will be approximately 20 na. (Full scale deflection on the neter is 50 ma. with shunt R_3 in lace.) A 150-ma. pilot lamp is next onnected to the antenna jack and C_8 djusted for maximum brilliance. hange the setting of C_5 slightly to ompensate for any changes in relected impedance.

The TVI trap is adjusted by tuning nearby TV set to a channel most usceptible to interference, usually hannel 2, and adjusting C_4 for mininum interference. This adjustment critical and should be made careully. If a bottom plate is used it hould be in place and the adjustment ade through a small hole drilled it.

After installation in the car it will e necessary to touch up the adjustents of C_5 and C_8 with the aid of a eld-strength meter.

Noise limiters are essential in mole communications and Figs. 2B and C show the "before" and "after" cirits of a typical second detector rcuit to which a shunt type noise niter has been added. The clipping vel is automatically adjusted by the v.c. voltage to the strength of the coming signal. In this installation e s.p.s.t. limiter switch was mounted the bottom of the receiver case by bracket. If it is necessary to extend e switch beyond the receiver be re to use shielded leads.

The complete receiver modification volves very few parts and very little

NEW— THE *World Master* NATIONAL NC-88

WORLD-BEATING RECEIVER AT A WORLD-BEATING PRICE!

For shortwave listeners and amateurs, here's a receiver that tops them all for value! Compare these features: ❶ Calibrated bandspread for 80, 40, 20, 15 and 10 meter bands (large 6″ indirectly-lighted lucite scales), ❷ Advanced A.C. superhet circuit uses 8 high gain miniature tubes plus rectifier, ❸ covers 540 kcs. to 40 mcs. in 4 bands, ❹ tuned R.F stage, ❺ two I.F. stages, ❻ 2 high-fidelity audio stages with phono input and 2-position tone control, ❼ built-in speaker, ❽ antenna trimmer, ❾ separate high frequency oscillator ❿ Sensitivity control, ⓫ series valve noise limiter, ⓬ delayed A.V.C. ⓭ headphone jack, ⓮ standby-receive switch . . . *And all this for only* **$119.95**

for radio's crowning achievements **National**

National Company, Inc., Malden, Mass. ® NC EST. 1914

SAVE $$—HOT SUMMER BUYS—SAVE $$

HERE'S ANSWER TO LOW ANGLE PROBLEM

20-40 METER GROUND PLANE ANTENNAS ARE PRACTICAL, USING OUR LIGHTWEIGHT MOLYBDENUM STEEL WHIPS. COPPER PLATED with baked paint finish, threaded tapered sections, standard 3/8 stud on bottom.

Five 16-ft. elements suitable for 20 meter ground plane, complete kit....$22.50

32-Foot VERTICAL WHIP.... 5.75

FOR MOBILEERS

LIGHTWEIGHT SECTIONAL WHIPS, easily demountable to prevent pilferage, fits std. car mounts. 8-footer..**$3.75** 12-footer. **$4.95** 16-footer..$ 6.95

CENTER LOADING COILS FOR ALL TYPES... 3.50

BRAND NEW DYNAMOTORS

6 VOLT INPUT, 180V/225 ma. output.......$ 9.95

6 VOLT INPUT, 350V/150 ma. output....... 9.95

6 VOLT INPUT, 500V/175 ma. output....... 14.95

12/24 VOLT INPUT, 350V/225 ma. output.. 11.95

12/24 VOLT INPUT, 625V/175 ma. output. 12.95

12 VOLT INPUT VIBRATORPAC, for operation in new model cars W/12 volt bat. del. 250V/40 ma.... 7.95

6 VOLT INPUT, 250V/50 ma. output, PM field requires low battery current.... 6.95

PE 101-C DYNAMOTORS, brand new in original cartons, operates on 6, 12, 24 volt input, special.... 4.45

DITTO, with cutdown endbells.... 4.95

DITTO, CONVERTED, ready to install.... 7.95

COMPACT 50 AMPERE CONTACTORS, for 6-12-24 volt operation, efficient remote control.... 3.45

EVEREADY #467, 67½V. B battery for portables, outdated but good as new, stock up at spec....5/ 1.95

Best* TV *Buy You've Ever Seen!

TRULY LIFE SIZE PICTURE • AUTOMATIC BEAM SUPPRESSOR • FLAT VIEWING SCREEN • FULL FOCUS • BUILT-IN ANTENNA • HIGH-FIDELITY SOUND SYSTEM • AUTOMATIC GAIN CONTROL • NEW IMPROVED PROTELGRAM (ADVANCED SCHMIDT) BIG-PICTURE SYSTEM DEVELOPED BY PHILIPS, WORLD FAMOUS ELECTRONICS LEADER • 23 TUBES PLUS 1 GERMANIUM DIODE • STANDARD TOP QUALITY COMPONENTS, INCLUDING "STANDARD COIL" TUNER • FULL SIZE CONSOLE—40½″ HIGH, 25″ WIDE, 21″ DEEP • SHIPPING WT.: 124 LBS.

GUARANTEED BRAND NEW!

SHIPPED IN ORIGINAL FACTORY SEALED CONTAINER, Our Price, Only..........Complete **$179.50**

Original List Price....................$399.95

LINK & BOSCH MOBILE POLICE RECEIVERS, 5 tubes (RF stage) fixed tunable 2-3 mc. adj. squelch control, W/6 volt power supply 250V/100 ma. IDEAL/Ham, C.D. MARS & MARINE services. Makes hot recvr w/HF converter, used operating cond. With new 5″ PM spkr...**$12.95**

ELECTRONIC SPECIALTY SUPPLY CO.

58 Walker Street, New York 13, New York

HARVEY
The House of Audio
25th ANNIVERSARY YEAR

THE ORIGINAL WILLIAMSON HR-15 AMPLIFIER KIT

The famous, original Williamson HR-15 . . . still acclaimed the leader . . . in kit form, with the original Partridge output Transformer. Assemble this kit, and in 3 hours or less, enjoy the finest sound you ever heard. Operates from a tuner, phono-preamp, crystal pick-up, or other signal source. Absolute gain is 70.8 db with 20 db of feedback. Frequency response: ± .5 db, from 10 to 100,000 cps. Output impedances to match all speakers from 1.7 to 109 ohms. Kit is complete with 5 tubes (1-5V4, 2-6SN7, and 2-5881 (or 807 if requested), 2-Punched Chassis, 2-Resistor Mounting Strips, Sockets, Partridge WWFB Output Transformer, Assembly Instructions, and All Other Necessary Parts for Amplifier and Power Supply. $76.50
HR-15 as above, but with Partridge CFB Output Transformers (hermetically sealed) **$90.00**
PARTRIDGE OUTPUT TRANSFORMERS available separately. **WWFB** ...... **$26.00** **CFB** **$40.00**
NOTE: HR-15 and Kits may be had with British KT-66 Output tubes for $3.00 additional.

PARTRIDGE Audio Output Transformers
Famous in England for their use in the original design of the Williamson Amplifier, Partridge Output Transformers are now made available in this country in four different primary impedances for other amplifier applications. These transformers are built to the very highest standards and are intended for equipment reproducing the full audio bands with the lowest possible distortion. All Model CFB transformers are hermetically sealed and will withstand climatic extremes. Power rating is 60 watts from 30 to 30,000 cps with less than 1% distortion without negative feedback.
Secondary windings furnish outputs to match the following loads: .95, 3.8, 8.5, 15.2, etc., to 60 ohms. Dimensions: 5⅝" x 5" x 5" high.
Weight: 10 lbs. Each **$40.00**
Specify Primary Impedence desired:
4000, 5000, 10,000 or 12,000 ohms.

ELDICO TR-75-TV TRANSMITTER KIT
This is an ideal unit for the novice. Very simple to assemble. New, revised circuit to aid in the elimination of TVI. Uses 6L6 oscillator — 807 amplifier combination. PI-network output. Husky power supply delivers 600 volts to the 807. Complete . . . including a punched chassis and shielded cabinet.
Unbelievably low priced at $64.95
MD-40 modulator kit for above $49.95
MD-40P as above but with power supply 59.95

Visit the Harvey AUDIOtorium
See, hear, and compare sound equipment from the largest selection available anywhere.

NOTE: Prices Net, F.O.B., N.Y.C.
Subject to change without notice.

hrc Harvey
RADIO COMPANY, INC.
103 W. 43rd St., N. Y. 36, N. Y. · JU 2-1500

work, as evidenced from Fig. 2. An octal socket and three-prong *Jones* socket (S-303-AB) to match the connector on the converter are all that is needed for the power supply. There will be no difficulty involved in mounting the 1N34 diode and the 47,000-ohm and 180,000-ohm resistors for the noise limiter circuit in most sets.

Experience with this station has shown that an efficient mobile setup is possible with only a "glove-compartmentfull", instead of a "trunkfull", of equipment. Try it, and see for yourself.

—30—

TRANSISTOR RECEIVER

By **M. E. QUISENBERRY**

Instrument Research Division
National Advisory Committee on Aeronautics, Langley Laboratories

An interesting toy for the youngsters that will fascinate adults as well—a wristwatch "Dick Tracy"—type radio set.

IN ORDER to provide my young daughter and her friends with a small, sturdy, "Dick Tracy" type receiver, the unit described herewith was designed and constructed. As is usually the case with such projects "for the kids," the neighborhood fathers are monopolizing it pretty completely.

This subminiature receiver is molded in a block of clear plastic which is only about half as high as a cigarette lighter. Two standard miniature *Ray-O-Vac* penlight flashlight batteries fit into the clip on top and the earset lead and short antenna wire come out of the side.

Tuning is by means of the knob soldered to the adjusting screw of a standard padder condenser. It is turned off by inserting a small piece of plastic under one of the battery clips.

By clipping the antenna wire to any convenient "aerial" normally found around the home (radiator, metal frame of a floor lamp, clothesline, etc.) normal phone volume and adequate selectivity on local stations are obtained. To reduce volume on the more powerful local stations, the receiver is tuned off-frequency slightly.

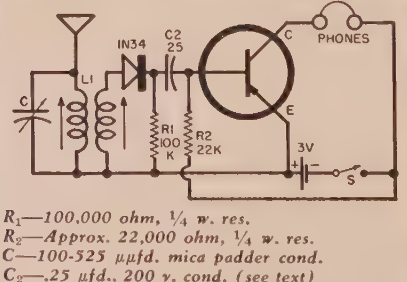
The antenna feeds directly into a high *"Q" Vari-Loopstick* antenna coil which has the mounting base cut off and the slug cut down to work into the small space. The brass screw to adjust the inductance of the coil is brought out the side below the tuning condenser as a range adjustment. The padder tuning condenser parallel-tunes this coil. The tuning condenser will tune the receiver from 1500 kc. down to about 750 kc. To tune below this point, turn the range adjustment screw in four or five turns. A pickup loop of from 30 to 50 turns is wound on the *Loopstick* form as near to the coil as possible and is fed into a 1N34 crystal detector. Over-coupling will lower the *"Q"* of the tuned *Loopstick* circuit. Too loose coupling will reduce sensitivity.

The signal from the detector circuit is capacity-coupled to the junction transistor audio amplifier through a small .25 µfd. condenser. If space is available the value of the .25 µfd. condenser should be increased to 2 µfd. or more. The junction transistor is connected as a grounded-emitter circuit giving a relatively high input impedance. The value of R_2 is chosen to give about 1 ma. in the collector circuit.

The entire unit can be fitted into the cardboard box in which ordinary "22" cartridges are packed or molded in *Paraplex* plastic, obtainable from chemical supply houses. The receiver can then be equipped with a strap and worn as a wrist-watch set if desired.

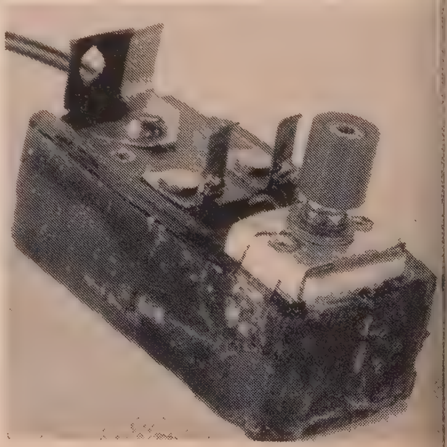
—30—

Circuit diagram of transistor receiver.



R_1—100,000 ohm, ¼ w. res.
R_2—Approx. 22,000 ohm, ¼ w. res.
C—100-525 µµfd. mica padder cond.
C_2—.25 µfd., 200 v. cond. (see text)
S_1—See text
L_1—Modified "Vari-Loopstick" (see text)
1—1N34 crystal diode ("Detector")
1—Junction transistor (Raytheon CK-722)
2—Miniature penlight cells (Ray-O-Vac #716)
1—2000 ohm earphone

The plastic-encased miniature radio set.



Radar Protects Fleet

(*Continued from page* 35)

consistent operation over the maxi-
num range under the most adverse
conditions. Operation is on an approx-
mate frequency of 3000 mc. The an-
enna is fed by a wave guide which
nay be seen in the photographs. This
vave guide is fitted with a rotating
oint at the antenna end.

Operation of the equipment requires
elatively little training which makes
t applicable for widespread use. Com-
plexity in equipment for use by un-
killed personnel would defeat its pur-
oose.

A great many other electronic navi-
gation safeguards are provided on a
vell-equipped boat such as this one.
n this particular boat a 100-watt
adiotelephone is provided for com-
nunication with other boats of the
leet, the Coast Guard, and shore sta-
ions. This equipment may be seen to
he left of the radar unit in the photo-
graphs, with the transmitter on the
bottom, and the receiver mounted on
op.

The equipment is a *Fisherfone*
Captain" manufactured by the *Fisher*
Research Laboratories of Palo Alto,
California. The transmitter may be
preset to any of five channels, with
nstant channel selection by means of
switch. A pilot light indicates which
hannel is in use.

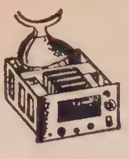
The receiver may be preset to ten
rystal-controlled channels or may be
nanually tuned for general coverage
f the marine band. Push-to-talk op-
ration is provided so that this equip-
nent is almost as simple to use as an
rdinary telephone. A restricted radio-
elephone permit, which may be ob-
ained by passing a very simple non-
echnical examination, is all that is
equired of the operator of this equip-
nent.

A switch on the receiver selects
ither the built-in speaker or the re-
eiver portion of the handset. In this
nanner conversations may be kept
emi-private if desired.

A reserve 50-watt, four-channel ra-
iotelephone transmitter-receiver, not
hown in the photographs, is also pro-
ided for emergency use in case the
nain equipment fails. This equipment
manufactured by the *National Com-*
any of Malden, Massachusetts.

To the right of the radar unit, and
artially concealed by it, is a direc-
on-finder receiver manufactured by
CA. This receiver, in conjunction
ith the loop antenna mounted on top
the wheelhouse, may be used to
ke bearings from radio stations and,
triangulation, the exact position of
e boat may be plotted.

The large case mounted above this
rection-finder, with the handwheel
rojecting below, is another direction-
nder manufactured by *Bludworth*.
s this unit is capable of tuning only
radio beacon stations, it is seldom
ed. It was installed by the U. S.



SPECIAL BUYS!

WHILE THEY LAST

300 ft. of 15 ohm coaxial cable $9.95
Attenuator—one cavity type.................. 7.95

BROADCAST BAND & AERO

Ideal for Use in Boats, etc.

MN-26-C Remote Controlled Navigational Direction finder and communications receiver. Manual DF in any one of three freq. bands. 150 to 1500 KC. 24 V. Self contained dynamotor supply. Complete installation, including receiver, control box, loop, azimuth control. Left-Right Indicator, plugs, loop transmission line and flex. shafts.

BRAND NEW	$89.50
LIKE NEW	$69.50
MN-26-Y 150 to 325 KC, 325 to 695 KC, 3.4 to 7 megacycles, comp. installation	$69.50
Receiver alone	35.95
MN-26-C alone, like new	39.50
MN-26-C or **MN-26-Y** as is less tubes	13.95
With tubes. Used good	24.95
MN-20-E Loop, Brand New	6.95
MN-52 Crank drive. New	2.50

SCR-274N COMMAND and ARC-5 EQUIPMENT

	AS IS	EXC. USED (With tubes)	NEW
BC-450 Control Box (3 Receiver)	....	$1.95	$3.95
BC-456 Modulator	$2.95	4.95	....
BC-451 Control Box (Transmitter)	....	1.95	3.95
BC-442 Relay Unit ANT With Condenser	....	3.95	....
Without Condenser	....	1.29	2.95
Flexible Shafting with Gear to fit receivers	....	....	2.45
3 Receiver Rack	....	2.29	2.98
2 Transmitter Rack	....	2.39	3.97
Single Transmitter Rack	....	2.25	2.95
DM-32 Dynamotor for Command Set	....	3.25	9.95
DM-33 Dynamotor for Command Set	....	2.95	3.95
Shock Mts. for 3 Receiver Rack, 2 Trans. Rack, Modulator or Ant. Relay Unit	....	1.95	2.45

WANTED!

All TS, APR, APS, ARC, ARN, ART, SCR, R89 and BC equipment . . . write today!
Quote lowest prices in your first letter

RT/34 APS 13 Transceiver used as a tail warning radar on 415 MC. Containing a 30MC IF Strip and various other parts, these units have been stripped of RF sections and all tubes, but are an excellent buy if only for parts and IF Strip..........used $ 4.95
BC 624 receiver (SCR 522), less tubes, 100-156MC ....used **14.95**

HAND SETS

TS9, excellent condition	$4.95
TS13, excellent condition	5.95
TS Type, exc., less cord	2.95

BC457 TRANSMITTER—4 to 5.3 mc and
BC458 TRANSMITTER—5.3 to 7 mc and
BC455 RECEIVER—6 to 9 mc (as is, less tubes and crystals)....................ONLY **$4.95** each
All three units.........................**$10.95**

"MONTHLY SPECIAL"

TRANSCEIVER—140-144 mc, 2 meter, used, excellent condition, less dynamotor, less tubes...............only $17.95

MIKES and HEADSETS

HS-33 Low Impedance Headset.	exc. $2.95	new $5.95
HS-23 Headset	used 2.95	new 4.95
CD-307 Ext. cord for HS 23-33		like new .79
Throat Mike—T 30		new .98
Lip Mike—Navy Type		new .98
CW 49505 High Impedance headset complete with headband		Used 98c
HB-7 Headband	used, exc. $1.29	
HS-18 Headset	used 1.29	new $1.98
HS-38	exc. 1.95	new 2.29
HS-30, miniature headset	used 1.49	new 2.49

WOBULATOR

BUILD TV-FM-AM SWEEP GENERATOR

You can build "Versatile Sweep Frequency Generator" with APN-1 magnetic units	$ 6.95
BC-1206 Beacon Receiver . . . 200-400KC	9.95
MN-26LB Receiver exc.	59.50
RCA Sound Powered Phones . . . brand new.	12.95
two for	24.95
TS3/AP . . . S-Band Power Frequency Meter	195.00
TS-184/AP Test Set	69.50
APR-2 Radar Search Receiver, 85-1000MC	195.00
APR-4 Radar Search Receiver, 38-4000MC	399.00
TS100 Oscilloscope	175.00
IE 19A-SCR522 Test Unit	295.00
MG-153 Inverter ...Used	69.50
I-222-Signal Generator ...Used, exc.	125.00
R-111B-APR5 ...Like new	350.00
AN/APT5 Transmitter ...Like new	189.50

DYNAMOTORS

The best dynamotor for conversion to 6v. Multiple windings! After conversion you get choice of 190 or 350 v. at 50 MA or 250 v. at 100 MA. Complete dope sheet furnished.
BRAND NEW (See "CQ" Aug. issue).......$4.65

Surprise Package!

SURPRISE PACKAGE. 15 lbs. of assorted good radio parts.
A real value at....................**$1.95**

MISCELLANEOUS EQUIPMENT

FL 8 used, exc....$1.19 **BC 347** each...used **95c**
BC 906 each...... 9.95
RI/ARR-1—Receiver, easily converted to 220 mc. (See Radio & Television News—Jan. '49.) Brand new, complete with Tubes **$4.95**

RT7/APN1 TRANSCEIVER UNIT—Used as an altimeter, it may be converted for signaling control circuits, etc. Complete with 14 tubes and dynamotor they are in good used condition at the amazingly low price of **$29.95**
Used, less tubes, as is.................... **4.95**

YE-4B

General Electric Delay Line Unit 1000 ohms + or − 10% band pass 0 — 2 mc; 4 micro-second delay time. Brand new **1.98**

SELSYN TRANSMITTER

Autosyn Transmitter Assembly for matching to I-82 Indicator. Used, excellent condition.
ONLY $10.95. Complete with Indicator...**$19.95**

RL-42 Reversible Motor with antenna reel and clutch, used ....$ 2.95
BC-433 RADIO COMPASS RECEIVER. 200 to 1700 KC, used, excellent condition, with **tubes** 39.95
used, exc., less tubes.................. 24.95
used, as is, less tubes and cover, exc. for parts 8.95

Shipments F.O.B. warehouse. 20% Deposit on orders. Minimum order $5.00. Illinois residents, add regular sales tax to remittance. Prices subject to change without notice.

R W ELECTRONICS Dept. N, 1712-14 S. Michigan Ave., Chicago 16, Ill.
PHONE: HArrison 7-9374

TRAIN FOR A SUPERVISORY POSITION IN

ELECTRONICS

Thorough 2-year course covers electrical circuits and machinery, basic electronics and industrial electronics. Franklin Technical Institute graduates are in demand as junior engineers for research and test work, sales engineering, supervisory work on production lines and drafting room design work. Other engineering and technical courses. Coed. Day, evening. 45th year. **Write for catalog.**

FRANKLIN TECHNICAL INSTITUTE
46 Berkeley Street Boston 16, Mass.

C O O K

The Standard Records for:
- **MUSICAL DEMONSTRATIONS**
- **ENGINEERING TESTS**

Send for complete catalog

COOK LABORATORIES
ROUTE 2 STAMFORD, CONN.

BARGAIN HUNTING? **RADIO SERVICEMEN!**
Write for SENSATIONAL CATALOG
HENSHAW RADIO SUPPLY
3619 TROOST KANSAS CITY, MO.

PERFORMANCE *Guaranteed* TO LAST A LIFETIME!

UNIVERSITY COBREFLEX-2 WIDE-ANGLE TRUMPET

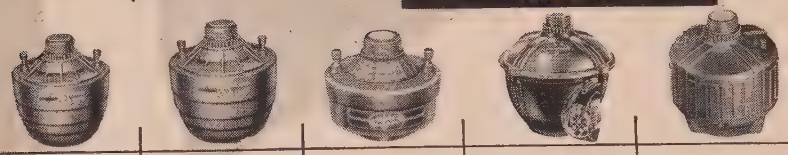
Lifetime Performance has been built-into each Cobreflex-2. Nothing yet produced compares in construction and design efficiency. Once installed, the Cobreflex-2 can be forgotten. The Cobreflex-2 is Breakdown-Proof . . . truly performance *guaranteed* to last a lifetime.

Compared! Tested! Proven Superior!

Write for technical literature

University

When used with University Driver Units
Meets Any Frequency Response / Power Capacity / Impedance Requirement / Mounting / Application



Model T-30 Driver Unit	Model SA-HF Driver Unit	Model MA-25 Driver Unit	Model PA-30 Driver Unit	Model SA-30 Driver Unit
Cont. Power: 20 Watts over 250 CPS Response: 250-15,000 CPS Impedance: 8 Ohms	Cont. Power: 25 Watts Response: 90-10,000 CPS Impedance: 16 Ohms	Cont. Power: 25 Watts Response: 90-6000 CPS Impedance: 16 Ohms	Cont. Power: 30 Watts Response: 80-10,000 CPS Impedance: 16/165/250/500 1000/2000 ohms Power Taps (70V): 30/20/10/5/2 5 Watts	Cont. Power: 30 Watts Response: 90-10,000 CPS Impedance: 16/45/165/250 500/1000/2000 ohms Power Taps (70V): 30/20/10/5/2 5 Watts

UNIVERSITY LOUDSPEAKERS • INC. 80 SOUTH KENSICO AVENUE, WHITE PLAINS, N. Y.

Windsor RADIO & TV RECEIVING TUBES

TESTED and GUARANTEED for PEAK PERFORMANCE

TO MERIT your confidence—to insure your satisfaction—every tube we ship has been tested in a radio or TV set for PEAK PERFORMANCE. Each tube is attractively packaged in individual carton—and, EACH WINDSOR Tube carries full RTMA GUARANTEE!

Type	Price	Type	Price	Type	Price
1B3GT	$0.63	6BH6	$0.57	12AT6	$0.48
1R5	.56	6BQ6GT	.89	12AT7	.68
1S5	.47	6BQ7	.84	12AU7	.53
1T4	.56	6C4	.37	12AV7	.79
1U4	.55	6CB6	.53	12AX7	.61
1U5	.46	6CD6G	1.85	12BA6	.45
1X2A	.67	6J5GT	.40	12BE6	.47
3V4	.56	6J6	.62	12BH7	.63
5R4GY	.91	6K6GT	.41	12SA7GT	.52
5U4G	.40	6S4	.46	12SK7GT	.50
6AB4	.46	6SH7GT	.47	12SQ7GT	.42
6AG5	.54	6SK7GT	.50	25BQ6GT	.89
6AK5	.95	6SL7GT	.62	25L6GT	.48
6AL5	.40	6SN7GT	.54	35B5	.48
6AQ5	.46	6SQ7GT	.42	35C5	.48
6AU6	.43	6T8	.77	35Z5GT	.30
6BA6	.45	6V6GT	.46	50B5	.47
6BC5	.53	6W4GT	.45	50C5	.47
6BE6	.46	6W6GT	.57	50L6GT	.47
6BG6G	1.34	6X4	.34	117Z3GT	.39
		6X5GT	.33		

WRITE FOR ADDITIONAL TUBE TYPES AND PRICES. We also stock Special Purpose and Transmitting Tubes at similar savings!
25% Deposit with Order. All merchandise F.O.B., N.Y.C. For orders less than $10, add $1 handling cost. Deduct 2% if full remittance accompanies order. All merchandise subject to prior sale and price change without notice. Dept. N-7.

Windsor ELECTRONIC TUBE CO.
1515-N SHEEPSHEAD BAY ROAD, BROOKLYN 35, N. Y.

MERIT POWER TRANSFORMERS
115 Volt 60 cycle Primary

120V/50MA/6.3V-1.5 AMP (P-3045)§	$2.73
150V/25MA/6.3V-.5 AMP (P-3046)§	1.76
480VCT/50MA/6.3V-2.5 AMP (P-3047)§	3.23
480VCT/40MA/5V-2 AMP/6.3VCT-2 AMP (P-2949)§	3.53
520VCT/70MA/5V-2 AMP/6.3V-3 AMP(P-3051)§	4.53
700VCT/90MA/5V-3 AMP/2.5VCT-12.5 AMP (P-2961)§	5.88
650VCT/40MA/5V-2 AMP/6.3VCT-2 AMP (P-2950)§	3.67
700VCT/90MA/5V-3 AMP/6.3VCT-3.5 AMP (P-2952)§	4.70
700VCT/120MA/5V-3 AMP/6.3VCT-4.7 AMP (P-2953)§	5.44
750VCT/150MA/5V-3 AMP/6.3VCT-5 AMP (P-2954)§	7.05
800VCT/200MA/5V-3 AMP/6.3VCT-5 AMP (P-2955)§	8.23
870VCT/250MA/5V-3 AMP/2.5V-10 AMP 6.3VCT-3 AMP/6.3 or 5V-3 AMP 80 VOLT BIAS TAP (P-2956)§	10.29
700VCT/225MA/5V-3 AMP/6.3V-10 AMP/ 6.3V-2.7 AMP (P-3070*	12.49
724VCT/295MA/5V-6 AMP/12.6VCT-5 AMP/ 51-2 AMP (P-3061)*	16.12
700VCT/200MA/5V-2 AMP/5V-3 AMP/6.3V-6 AMP/6.3V-7 AMP (P-3165)‡	10.58
800VCT/300MA/5V-3 AMP/5V-6 AMP/12.6VCT-10 AMP (P-3166)‡	17.64
1750V/2MA/2.5V-2 AMP/6.3V-.9 AMP/6.3 or 2.5V-2 AMP (P-3170)‡	6.17
2500V/5MA/2.5V-2 AMP/6.3V-3 AMP/6.3 or 2.5V-3 AMP (P-3171)§	8.23

§Half Shell Mount. *TV Replacement ‡Upright Mount

HYTRON TEST ADAPTERS

7 pin minature	$1.42
8 pin octal	2.30
9 pin minature	1.70

HYTRON TOOLS AND AIDS

Tube Lifter	.14
Soldering aid	.48
Probing tweezers	.34
Tube puller	.73
7 & 9 pin straighteners	.54

HYTRON POINT CONTACT TRANSISTORS

PT-2S	17.40
PT-2A	17.40
T-2 socket	.30

SPECIALS

No. 14 enamel 100 ft. coil	.95
No. 12 enamel 100 ft. coil	1.25
No. 10 enamel 100 ft. coil	2.45
NE-40 3 watt neons	.38
2½ watt argons	.19
NE-2 neons with leads	.08
100—½ watt resistors (asst'd)	1.00
25W—'50 OHM wire wd rheostat	.58
6VDC to 110 VAC—40 watt supply	9.95

All prices F.O.B. our warehouse New York

LEEDS RADIO CO.
75 Vesey St. Dept. A New York City 7

Army during World War II when they leased the boat.

The loop antenna of the *Bludworth* direction-finder is also used with the *RCA* direction-finder, avoiding duplication of antennas. The antenna is rotated by means of the handwheel projecting below the *Bludworth* unit. Bearings of the received stations are indicated directly on the dial of the *Bludworth* direction-finder.

Additional electronic equipment includes two fathometers to indicate depth of water. Both units are manufactured by *Submarine Signal Company*. One unit has a calibrated range of 400 feet, while the other has a range of 1000 fathoms.

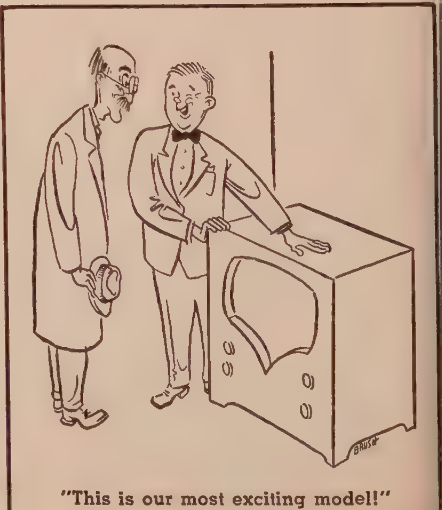
Fathometers operate on a principle similar to radar, with a supersonic signal being transmitted instead of the microwave signal. This signal is sent out by a special transducer, mounted under the boat. When this supersonic wave strikes an object, it is reflected and picked up by a special underwater microphone. The received signal is amplified and fed to an indicator. The indicator shows the elapsed time between the transmitted and received signal, and is calibrated directly in feet or fathoms.

In harbor navigation the 400-foot unit is particularly useful to indicate submerged reefs or other obstacles. For deep-sea navigation, the 1000-fathom unit is used.

The 400-foot unit has another application in that it can be used to give an indication of large schools of fish. Large schools of fish will show on the indicator dial as a false bottom. By skillful interpretation of the readings it is frequently possible to locate good fishing grounds.

The art of deep-sea fishing is as old as man himself, but adoption of electronic techniques has done much to raise this from a catch-as-catch-can status to one of science. Further developments in this field will undoubtedly do much to reduce the element of chance. In addition, the safety of those who man these fleets has been greatly increased by the electronic developments of the past few years.

—30—



"This is our most exciting model!"

STAN-BURN
S-P-A-R-K-S

CATHODE RAY TUBE SPECIALS
One Year Guarantee

G. E.		STAN-BURN	
5TP4	$44.95	10BP4A	$11.00
7JP4	17.10	12LP4A	14.20
10BP4A	19.25	14CP4	17.00
10FP4A	24.00	15DP4	19.50
12KP4A	27.10	16AP4	21.60
12LP4A	21.70	16FP4	19.60
12UP4B	28.25	16GP4	21.60
14CP4	24.50	16EP4A	22.60
16AP4A	30.95	16DP/HP4	19.60
16DP4A	28.20	16DP/HP4A	20.60
16GP4	31.25	16KP4	18.50
16KP4/16RP4	28.20	16LP4	20.60
17BP4A	23.90	16LP4A	21.60
17CP4	23.90	17BP4	18.50
19AP4A	39.45	17CP4	21.60
20CP4	24.75	19AP4	23.90
20LP4	37.50	19AP4A	25.90
21EP4A	37.35	20CP4	29.50
24AP4A	78.50	21EP4	32.50

ANTENNAE SPECIALS

	1-11	12 or more
RED DOUBLE "V" Antenna	$2.29	$2.09
RMS EVA 100 DOUBLE "V" Antenna	2.49	2.39
10 Element Conical 3/8"	3.55	2.55
Folded Hi Straight Low Quick Rig 1/2" elements	4.25	3.25
WINDOW CONICALS	4.95	3.75
MASTS		
5 FOOT SWEDGED	.79	.69
10 FOOT PLAIN	1.39	1.29
NEPCO MASTS	1.69	1.49

TV WIRE

42 Mil.	$ 9.95 M Ft.
55 Mil. 300 OHM	11.95 M Ft.
72 OHM COAXIAL	38.00 M Ft.

12" Heavy Slug Speaker..............Special $3.98

CHASSIS 630 REGAL with Cascode Tuner.$149.50
OPEN FACE CABINET.............. 42.00

WIRE RECORDERS IN STOCK
PENTRON — Model 9T3C — 2-speed Tape Recorder..........................Write for Price.
RADIO CRAFTSMAN
Model C400—Hi-Fi Amplifier ....Net 42.90
Model C10—AM-FM Tuner ....Net 131.50
Model C500—Williamson Amplifier...Net 99.50
We also carry MASCO—BOGEN—PILOT, etc., Amplifiers, Pre-Amps, FM Tuners and WEBSTER Tape Recorders.

6x9 PM Speaker	$ 3.98	630 Vert.. output potted	1.29
7" PM Speaker	3.98	630 Vert. Blocking OSC. XForm	.89
77J1 G.E. Flyback	1.98	Cascode Tuners	19.95
70° Yoke	1.98	Standard Tuners	17.95
630 Vert.. output upright	1.98	Dumont 21.25 mc.	14.95

AUTHORIZED DISTRIBUTORS for General Electric, Kenrad, Tung-Sol, National Union, De Wald, Regal, Automatic and General Motors.

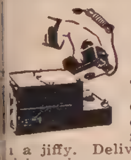
Automatic Custom-Built Radios for Plymouth, Ford, Chevrolet and many others, always in stock.

We carry a Complete line of HI-FIDELITY and sound equipment. Send us your requests.

We also carry a complete line of popular makes of Radio Tubes at 50 10 discount. Also many other special purpose and transmitting types, and all electronic parts and equipment at lowest prices. Send us a list of your requirements for prompt quotations.
Terms: 20% with order. Balance C.O.D. All prices F.O.B., NEW YORK Warehouse. Minimum order $5.00. Write for our latest price list and Hi-Fi catalog to Dept. RN-7.

STAN-BURN RADIO and ELECTRONICS CO.
(C.B.S. THEATRE BLDG.)
1697 BROADWAY • NEW YORK 19, N.Y.

Please Mention
RADIO & TELEVISION NEWS
When Answering Advertisements



110V, AC POWER SUPPLY FOR ANY 274-N RECEIVER

Just plug it into the rear of your 274-N RECEIVER . . . any model. Complete kit and black metal case, with ALL parts and diagrams. Simple and easy to build in a jiffy. Delivers 24 volts plus B voltage. No wiring changes to be made. Designed especially for the 274-N receiver. **Only $8.95.**

ilament trans. for 274N receivers. Pri. 110V, 0 cy. AC. Sec. 24V @ .6A. An excellent buy ....$1.95 ea.

PLINED TUNING KNOB FOR 274N RECEIVERS

n exclusive O-R item manuctured for us. Fits BC-453, C-454 and other 274N reivers. This is a really hard-obtain item. Only..89c ea.

OFFENBACH-REIMUS
564 Market Street, San Francisco, Calif.

Dage TV Camera

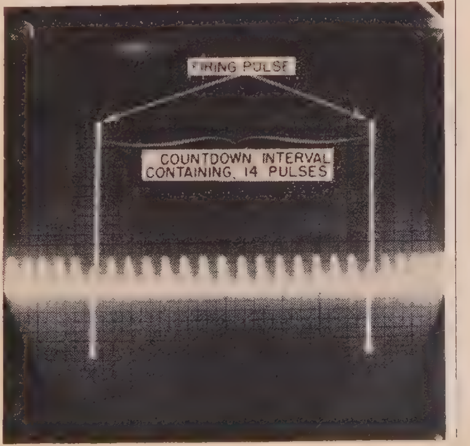
(*Continued from page 34*)

the high-side of an audio oscillator adjusted to 15,750 cps. In this way the audio oscillator beats with the second harmonic provided by the 31,500 cycle master oscillator and a zero beat may be obtained from the use of the germanium diode. Listening to the phones, the operator varies the 31,500 cycle "Adjust" control (screwdriver-adjust chassis control) in the grid circuit of the master oscillator for zero beat. Although a number of tones may be heard, depending upon how far out of range the 15,750 cycle "Adjust" control in the $\div 2$ circuit happens to be, variation of the master oscillator control allows the operator to distinguish the second harmonic beat from the others. After this zero beat is obtained, the 15,750 cycle "Adjust" control is varied for zero beat with the remaining tone. An oscilloscope connected to "Test Plug $\div 2$" will now show the pattern illustrated in Fig. 7. This indicates that every second pulse is syncing the $\div 2$ counter whose free-running frequency is close to 15,750 cycles.

Germanium diodes are employed in the interstage coupling networks of each vertical divider chain to bring the firing time into synchronism and for effective stage isolation to prevent interaction. Each divider is accurately adjusted by connecting the oscilloscope to the "Test Plugs" for that particular divider as noted in Fig. 6. Fig. 11 shows the pattern obtained at "Test Plug $\div 15$" indicating that every 15th pulse synchronizes the oscillator when the 2100-cycle "Adjust" control ($31{,}500 \div 15$) is properly adjusted. The same procedure is carried out through the remaining $\div 7$ and $\div 5$ counters. Tube V_{10A} is the final countdown for the vertical pulses, supplying 60 pps to the blanking amplifier V_{14A}, the camera vertical pulse amplifier V_{10B} and monitor vertical amplifier V_{11}.

The blanking amplifier V_{14A} receives the vertical pulses on the grid, while

Fig. 11. "Divided by 15" counter pulses on scope when connected to "Test Plug $\div$ 15". Every 15th pulse triggers $\div$ 15 oscillator.



Trav-Electric CONVERTERS

CHANGE 6 OR 12 VOLT D.C. TO 110 VOLT A.C. 60 CYCLE
Just plug into Cigar Lighter on Dash.

Trav-Electric
Super
Model 6-71160
60 cycle
60-75 Watts
$37.95 LIST

Size 4"x5"x6"
Operates
- Wire Recorders
- Amplifiers
- Soldering Iron
- Dictating Machines
- Turntables
- Small Electric Drill

Trav-Electric
Master
Model 6-51160
60 cycle
40-50 Watts
$24.95 LIST

Size 4"x5"x6"
Operates
- Curling Irons
- Radios
- Turntables
- Small Dictating Machines
- Test Equipment, etc.
- Portable Phonographs

Trav-Electric
Senior
Model 6-1160
60 cycle
35-40 Watts
$15.95 LIST

Size 2½"x2½"x4½" Operates
- Test Equipment
- Turntables
- Lights
- Short, Long Wave Radios
- Portable Phonographs
- Electric Shavers, etc.

Trav-Electric
Midget
Model 6-11160
60 cycle
10-15 Watts
$10.95 LIST
Size 2"x2"x3½"
Operates Test Equipment, All Electric Shavers

Fully Guaranteed
See Your Jobber or Dealer

TERADO COMPANY
MFRS. OF PRECISION EQUIPMENT
1068 RAYMOND AVE. • ST. PAUL 14, MINN.
In Canada write: Atlas Radio Corp., Ltd.
560 King St. West, Toronto 28, Ont.
Export Sales Division: Scheel International, Inc.,
4237 N. Lincoln Ave., Chicago 18, Ill., U. S. A.
Cable Address—*Harscheel*

SELECTED SURPLUS

NON-INDUCTIVE RESISTORS
Ohmite, 250 Ohm, 100 Watt. 59¢
Special, 5 for $2.50

SOLA CONSTANT VOLT. TRANSF.
Pri. 95-125 volts, 60 cy. Sec. Regulated at 115 volts.................. 30 VA. $ 9.95
120 VA. $22.50

OIL CONDENSER SALE

2 MFD—2500 VDC	$2.95	3.75 mfd 660VAC	$2.45
4 MFD—2500 VDC	5.95	.1 mfd 7500VDC	1.75
2 MFD—3000 VDC	3.95	.1 12KV DC	2.95
3 MFD—4000 VDC	5.95	.01x ..01 12KV DC	2.95
1 MFD—5000 VDC	2.95	5 mfd 660 VAC	2.95

6 HY, 400 MA FILTER CHOKE
Made by Acme. Only 30 Ohms DC Res. $2.50
ALL BRAND NEW.
Priced at a fraction of cost. 3 for $6.50

0-150 MICROAMP METER
G.E., 2" flush Bakelite case. Scale 0-150 Microamps. BRAND NEW. A Terrific Value. $4.95

G.E. PLATE TRANSFORMER
Pri. 120 V., 60 cy. Sec. 1140 Volts Ct. @ 1 amp. Ideal for Bridge Rect. Fully Cased, Herm. Sealed. In original cartons. ONLY....ea. $16.95

MOBILE DYNAMOTORS
MADE BY PIONEER AND EICOR
6 Volts Input, 425 Volts at 375 MA Output. 6¾" Long. 4" Diameter. Weight 10 lbs. List Price Approx. $70.00.
BRAND NEW, ONLY......... $24.95

CARTER SUPER DYNAMOTOR
12 Volts Input, 400 V. Output @ 200 MA Continuous or 375 MA Intermittent duty. Model B420. Designed for Police, Aircraft and Marine Use. Small, rugged and efficient.
BRAND NEW, ONLY.............. $24.95 Each

G. E. RELAY CONTROL
(Ideal for Model Controls, Etc.)
Contains a sigma midget 8,000 ohm, relay (trips at less than 2 MA), high impedance choke, bimetal strip, neon pilot and many useful parts. The sensitive relay alone is worth much more than the total low price of....$1.25 Each 10 for $9.90

Panel Meters
NEW GOV'T SURPLUS
STANDARD BRANDS

2" METERS	
0-10 MA AC	$2.95
3" METERS	
0-50 Microamps	$8.95
0-100 Microamps	7.95
0-200 Microamps	6.95
0-400 Microamps	5.95
0-500 Microamps	5.95
0-10 Milliamp	4.50
0-150 Milliamp	4.50
0-200 Milliamp	4.50
0-300 Milliamp	4.50
0-500 Milliamp	4.50
0-1000 Milliamp	4.50
0-50 Volt DC (1 MA)	4.95
0-150 V. DC (1 MA)	4.95
0-1.5 Volts AC	4.95
0-3 Volts AC	4.95
0-150 Volts AC	7.50
0-15 KV DC w/ multiplier	9.95
4" METERS	
0-200 Microamps	$8.95

METER BUY OF THE YEAR!
2" Simpson Meters
Round bakelite case. Brand new, original cartons.
0-1 MA DC. $3.95
0-300 Volts DC, 1000 Ohms/v (1 MA) .. $3.95
DB Meter —10 to +20 ..... $3.95
ANY 3 METERS. $11.50

WIRE WOUND RESISTORS
Stock too long to list. We can supply most sizes, so order what you need.

5 Watts. From 1 Ohm to 40K Ohms..Ea.	$ .09
10 Watts. From 1 Ohm to 70K Ohms..Ea.	.15
20 Watts. From 4 Ohms to 50K Ohms..Ea.	.20
25 Watts. From 1 Ohm to 100K Ohms..Ea.	.30
50 Watts. From 5 Ohms to 100K Ohms..Ea.	.40
100 Watts. From 50 Ohms to 100K Ohms..Ea.	.50

ADJUSTABLE SLIDER, WIRE WOUND

10 Watts from 1 Ohm to 10K	$ .25
25 Watts from 20 Ohms to 2.5K	.35

VACUUM CONDENSERS

50 mmf. 32 KV, Eimac	$9.95
50 mmf. 20 KV, Jennings	7.95

1 MEGOHM, 1% W.W. PRECISION RESISTORS,
SHALLCROSS. ONLY ....97c ea.; 10 for $8.95

BAKELITE CASED MICAS

MFD	VDC	Price	MFD	VDC	Price	MFD	VDC	Price
.001	600	$ .18	.01	1 KV	$ .45	.02	2 KV	$ .90
.002	600	.24	.002	1200	.35	.005	2500	.55
.01	600	.26	.024	1500	.65	.002	2500	.45
.02	600	.26	.033	1500	.75	.004	2500	.50

Min. Order $3.00—25% with Order
PEAK ELECTRONICS CO.
66 West Broadway, New York 7, N. Y.
Phone WOrth 2-5439

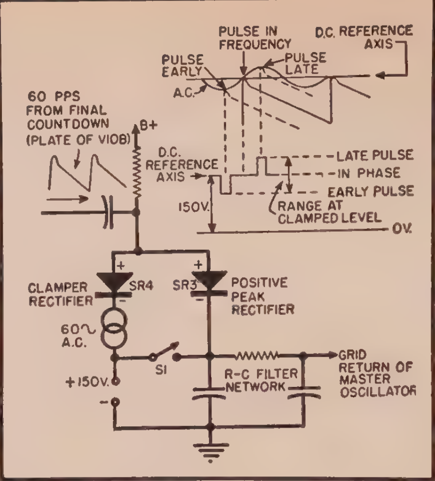


Fig. 12. The clamping-comparison line lock.

horizontal pulses are injected on its cathode from the V_{12} stage. In this manner the composite sync-blanking pulses of negative polarity appear at the plate and are injected into the grid of V_5 as described for Fig. 8. Fig. 9 shows the rectified composite output signal displayed at line frequency, and Fig. 10 illustrates the field frequency.

Horizontal and vertical size and linearity controls for Vidicon sweep are incorporated as screwdriver-adjustable chassis controls. The amplitude of vertical sweep ("Camera Height Control") is determined by the setting of a potentiometer in the grid excitation branch of V_{10B}. A separate potentiometer across the resistors which determine the bias on the V_{10B} grid serves to adjust the tube transfer-curve characteristics and is the sweep "Vertical Linearity Control". The two adjustments are obviously interdependent in action. The camera "Width Control" is an adjustable condenser between the ÷2 counter output (V_{8B}) and the camera horizontal output stage V_{12}.

The master oscillator can be locked in operation by the 60 cycle a.c. power line frequency by means of a unique clamping-comparison circuit. Two selenium diode rectifiers are used as indicated in the simplified schematic of Fig. 12. The action is based upon the fact that the blocking time of the oscillator is dependent not only upon the *RC* time constant of its grid circuit, but also upon a static grid potential which determines the extent to which the grid condenser may charge during the "on" time. Pulses from the final vertical countdown (60 pps) are combined with a fixed d.c. potential upon which is superimposed a 60 cycle a.c. line voltage, and the resultant clamped voltage is used to vary this static grid potential and automatically correct the master oscillator frequency.

The fixed reference d.c. potential is applied at the cathode of SR_4 in series with the a.c. filament winding *Y-Y* (Fig. 6). The anodes of SR_3 and SR_4 are parallel connected across a d.c. potential and pulses from the

SUMMER CLEARANCE
PRICES SLASHED

T.V. TUBES—ROCK BOTTOM PRICES
In lots of 6 each No. only

6BG6	.89c	6CB6	.39c	6AQ5	.38c
19BG6	.89c	6AK5	.69c	6CD6	$1.05
12AX7	.47c	6BQ6	.57c	6S4	.49c

Tube Special—Broken Keys—Electrically Perfect
12A6...29c; 4 for $1.00 12K8...49c; 7 for $3.00

Tube Sale—#2A7-55-27-85-31-56. No Mixed Ass't. 6 of Any Type $2.25

Heavy Duty Shielded P.P. Input Trans.........$1.00
H.D. Silver Contact Trans. Keys............. 1.00

Bat Handle S.P.S.T. or D.P.S.T. Toggle Switch. 25c

Isolantite Octal Panel Clamp Sockets.........3c ea.

100 Assorted Resistors....................$1.95

1 Mfd., 1,000V Oil Filled Cond. 75c

2 Gang Var. Cond. 456 K.C. with Osc. Section. 2¾ in. Pulley on ⅜" Shaft.............. 49c

Westinghouse Kuprox Rectifier 0.64 Amp. 28 Volts. Reg. $11.00 ea. Special...........$1.95

BRAND NEW 10" PHONO RECORDS—Ass't. Jazz—Popular. Rhythm—Blues. Please specify. 12 for $1.79 or 24 for $3.00

Single Pole—10 Pos. 2 Gang Switch...........29c

Grind your own Crystals. Pure Brazilian Quartz. Various sizes and thicknesses. ¼ lb. pkg.......$1.00

4 Tube Drilled Chassis, 4½"x6½"x1½". 29c each

Signal Corps Phones—2 M. Ohms (8 M. Ohms Imp.)...........................$1.25
2 Ft. Ext. Cord (and Plug)................. 40c

TOBE TUBULAR ELECTROLYTICS
20-20 MFD. 150 V...49c 30-30 MFD. 150 V...57c
40-40 MFD. 150 V...59c

Low-Loss Short Wave Lock Type Air Trimmer Variable Condensers
5 Pl.—20Mmfd. 14c
7 Pl.—25-30 Mmfd..15c
8 Pl.—30-35 Mmfd..16c
14 Pl.—56 Mmfd.....24c

3 GANG T.R.F. VARIABLE CONDENSERS .000365 Con. 65c

D.P.D.T. SLIDE TOGGLE SWITCH 15c

1,000 OHM WIRE WOUND POTENTIOMETER....15c
30 HY-FILTER CHOKE SHIELDED.......3 for $1.25

PIEZO CRYSTAL HOLDERS..12 for $1.00—$6.00 per C

RCA Band Switches—
3 gang, 3 pos. 3 band.30c 6 gang. 4 pos. 4-5 band.40c

Trimmer-Padder Asst.—all isolantite—singles, dual; triples—100 asst. $2.25

ATTENTION: Prospectors, Explorers for Hidden Treasures! Construct a U.S. Army Type of Metallic Mine Detector Amplifier. Amplifier unit only (less tubes and batteries) with cables, headphone cord, and jack. Army wiring diagram. Type AN/PRS-1.............$1.95

Philco push button Rotary Switch Double Pole....35c

8 or 9 Gang Push Button Switch...............49c

DRILLED CHASSIS FOR 5-6 tubes 5"x10"x1½"..25c
PHONE JACKS—OPEN & CLOSED AUTO..........18c
156-1 RATIO VERNIER DIALS—4 in., ⅜ in. Hub.35c
SALE—PHONO RECORD ALBUMS—12"—3 comp.—15c; 10"—3 comp.—15c; 4 comp.—20c; 12 comp.—69c

VULCAN HEAVY DUTY 100 WATT SOLDERING IRON. Built for U.S.N.—Brand New—Equiv. sells for $8.50..........................OUR PRICE $2.99

MINIMUM ORDER $3.00—NO C.O.D.
SHIPMENTS—PLEASE INCLUDE POSTAGE
NEWARK SURPLUS MATERIALS CO.
324 Plane Street, Dept. JY, NEWARK 1, N. J.

SAY YOU SAW IT IN
RADIO & TELEVISION NEW

COMPLETE TV AERIAL KIT

Consisting of:
- Hi-Low antenna
- 7-ft. heavy duty mast
- 75-ft. 300 ohm w
- 50-ft. guywire
- Sturdy swivel b
- 6 stand-off insulators

Special Priced 47 Bo

STRAIGHT LOW TV AERIAL AR2
Only 17

Servicemen's array pre-assembled. band array only, w mast clamps for m up to 1¼".

10% CASH WITH ORDE

ALMO RADIO CO
509 ARCH ST. & 6205 MARKET
Philadelphia, Pa.
6th & ORANGE STS. • Wilmington, D
4401 VENTNOR AVE. • Atlantic City, N.
1133 HADDON AVE. • Camden, N.
317 Park Heights Avenue • Salisbury,

final countdown (hence dependent upon master oscillator frequency) are injected at this point. With the "Line-Lock" switch S_1 closed (unlocked position) the static grid potential is fixed by the d.c. potential of 150 volts. The comparison function is shorted out in this position of the switch. With S_1 open (line-lock position) the cathode of SR_4 is varied above and below the d.c. reference potential at the 60 cps line rate. Injection of the 60 pps from the final countdown to the anodes results in a clamped value at SR_4 dependent upon the relative frequency with the 60 cycle variation. SR_3 serves as the positive peak rectifier for the clamped pulse. If the master oscillator and all frequency dividers are exactly adjusted, the 60 pps coincide with the 60 cycle variations, and the voltage is clamped at the d.c. reference potential. (See waveforms, Fig. 12.) If the 60 pps from the final counter are early or late (too high or too low in frequency) the clamped level falls in the negative direction or rises in the positive direction. The level change is filtered to pure d.c. correction at the output of the filter network to which the master oscillator grid is returned. The direction of change is such that the cut-off period is shortened if the frequency was too low, or lengthened if the frequency was too high.

The author wishes to thank George Fathauer, inventor of this system and president of the *Dage Electronics Corp.*, for supplying the technical data on the camera and permission to publish this article.

—30—

WIRELESS OPS OF "OLD"

FOR some time we have been considering a column dedicated to "Old Time Wireless Operators"—not "Radio Operators" for that appellation is too modern. We believe that we may have something along that line in the near future as our mail has brought us a reminder that 1952 was the 40th anniversary of the sinking of the "S.S. Titanic" in the North Atlantic and the subsequent employment of a large number of wireless operators for our American passenger ships.

It was in 1912 that our radio men put on long pants and became an integral part of American shipping. What has become of these men? Through this column we are going to try and find out what goes with the "Old Timers."

Our compliments to all "Old Timers" of 1912 and thereabouts and we would certainly appreciate your writing us as to when and where you first became a "commercial" operator, either ashore or afloat and by whom you were employed. We would also like to know how long you continued as a commercial radio operator and what you are doing now. A recent picture of yourself would also add interest to the column as would career highlights.

We feel that your story will be of interest to our readers, so you old brass pounders get busy and write us, in care of this column, and watch for its early appearance.

—30—

SEE LEO FIRST FOR . . . .

hallicrafters

I can SAVE you money . . . Liberal Trade-ins

LEO I. MEYERSON WØGFQ

JUST ARRIVED! THE NEW 100 WATT HT-20 XMTR—$449.50

$179.50

S-76 RECEIVER

Extra selectivity with double superhetrodyne circuit. One RF, two conversion and 3 IF stages. Range 550-1550 Kc, 1.7-34 Mc in four bands. 8 tubes plus voltage regulator and rectifier. Complete with tubes, less speaker.

$224.50

SX-71 RECEIVER

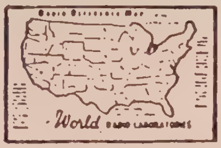
Double Conversion sharp selectivity, plus built-in NBFM at moderate cost. 11 tubes plus voltage regulator and rectifier. Low down payment.

NAME YOUR TERMS • LOW DOWN PAYMENTS • PERSONALIZED SERVICE

HALLICRAFTERS RECEIVERS AVAILABLE FOR IMMEDIATE SHIPMENT

S-81 ....$49.50
S-82 ....$49.50
A-84 ....$99.50
S-38C $49.50
S-40B $119.95
S-53A .... $ 89.95
S-72L $119.95
S-77A $119.95
ST-83 ....$129.95
S-78A ....$ 89.50
SX-62 ....$299.50
S-72 Portable $109.95
R-46 Speaker $19.95
SX-73....................$975.00

Famous WRL RADIO REFERENCE MAP 25c


CU on 10-20 & 75 Meters

NEW LOG BOOK 25c

For mobile or fixed station. Spiral binding. Full column log listing all FCC required info. Will accommodate 1,525 stations. "Q" signals, phonetic alphabet, amateur international prefixes.

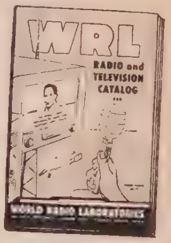
PHONE 7795 WRITE—WIRE

IT'S NEW! IT'S FREE!

WRL 1953 CATALOG

Send for your copy today. Contains everything new in radio and television. Jam-packed with bargains. Leo I. Meyerson, WØGFQ

Send For FREE Copy



World Radio LABORATORIES INCORPORATED COUNCIL BLUFFS, IOWA
EVERYTHING IN RADIO

WORLD RADIO LABORATORIES R-7
744 West Broadway
Council Bluffs, Iowa

Please send me:
☐ Radio Map 25¢
☐ New Catalog
☐ Used Equipment List
☐ SX-71 Info
☐ S-76 Info
☐ New Log Book 25¢

Name ....
Address ....
City.................... State............

SPEAKER RECONING

Complete line Cones, Spiders, Rings and Voice Coils. Custom Built Voice Coils. Low prices. Write for Parts List and Reconing information.

WESTERN ELECTRONICS CO.
3164 West Colfax Denver 4, Colo.

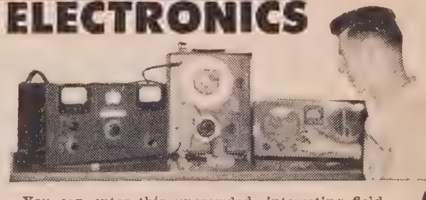
ON-THE-SPOT BATTERY RECORDER

WALKIE-RECORDALL 8 lb. miniature BATTERY RECORDER-PLAYBACK

Continuous, permanent, accurate, indexed recording at only 5c per hr. Instantaneous, permanent playback. Picks up sound up to 60 ft. Records conferences, lectures, dictation, 2-way phone & sales talks: while walking, riding or flying. Records in closed briefcase with "hidden mike"! Write for Detailed Literature.

MILES REPRODUCER CO., INC.
812 BROADWAY Dep't RN-7, NEW YORK 3, N. Y.

GET INTO ELECTRONICS



You can enter this uncrowded, interesting field. Defense expansion, new developments demand trained specialists. Study all phases radio & electronics theory and practice: TV; FM; broadcasting; servicing; aviation, marine, police radio. 18-month course. Graduates in demand by major companies. H.S. or equivalent required. Begin Jan., March, June, Sept. Campus life. Write for catalog.

VALPARAISO TECHNICAL INSTITUTE
Dept. RD Valparaiso, Indiana

Here's the new SHURE

SLIM-X

All-Purpose Crystal

MICROPHONE

Its Versatility and "Hand-a-Bility" make it an ideal low-cost all-purpose microphone

SLIM

STURDY

Smart

LIGHT! The new "777" Slim-X Microphones are rugged little microphones weighing only 6 ounces! They are designed for good-quality voice and music reproduction. Their versatility and "hand-a-bility" make them ideal for use by lecturers, announcers, instructors, and Hams; for audience participation shows; carnivals; panel and quiz shows; and use with home-recorders. When mounted on either cradle or swivel, the "777" can be removed in a flash (no tools necessary)—simply by lifting it out of the holder. This makes it an ideal "walk-around" hand-held microphone.

TECHNICAL INFORMATION: Smooth frequency response—60 to 10,000 c.p.s.; special-sealed crystal element—for long operating life; high impedance; 7' single-conductor cable, disconnect type. Dimensions: (Microphone only) Length, 4½"; Diameter 1". *Finish:* Rich satin chrome overall.

NOTE: Lavalier cord for suspension of Microphone around neck is available. (optional).

ACCESSORIES FOR "777"

MODEL S38 STAND is a heavy die-cast base. Includes metal screw machine stud for connecting microphone adaptor to stand base.

List Price: $3.00

MODEL A25 SWIVEL ADAPTOR features a long-life, high-quality swivel connector. Is lined with a long-life nylon sleeve—for noise-free and scratch-free insertion and removal of microphone.

List Price: $5.00

SHURE

SHURE BROTHERS, Inc.
MICROPHONES and ACOUSTIC DEVICES
225 W. Huron St., Chicago 10, Ill., Cable: SHUREMICRO

125-Watt Audio System

(*Continued from page* 41)

voltage is connected to terminals 3 and 4. The remote control relay coil is supplied through terminals 5 and 6, while terminals 7, 8, and 9 receive audio voltage from the speech amplifier section. Also mounted on the rear of the modulator chassis is a bayonet-type fuse holder.

No under-chassis view is shown of the modulator, as the only parts located there are the filament transformers and relays, and these parts can be mounted in any convenient location.

For front panel views we turn to the photograph showing the complete transmitter. Three units make up the entire rig, with the r.f. section (see RADIO & TELEVISION NEWS, June, 1952), at the top. Below the r.f. section is the modulator panel, and at the bottom is the speech amplifier unit.

Looking first at the modulator panel we find the 811 plate current meter at the center. Below, near the bottom of the panel, are the filament switch, filament pilot light, plate pilot light, and plate switch.

Components mounted on the speech amplifier panel are: Input control, R_5, output control, R_{13}, and a dummy knob was used to balance the front panel layout. Below the knobs are located the microphone connector, clipper "in-out" switch, a.c. switch, and pilot light.

Aluminum was used for all foundation components. All chassis are 12 x 17 x 3 inches in size and all panels are 8¾ x 19 inches. Chassis-mounting brackets were used to strengthen the units. These were cut and bent from 16-gauge sheet aluminum at a local sheet-metal shop.

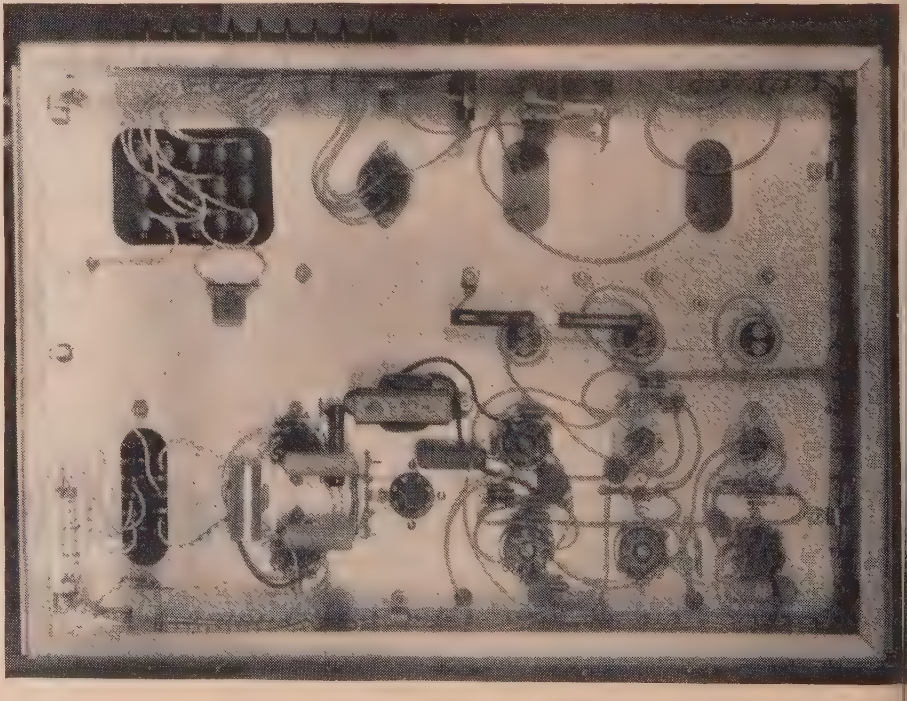
The chassis were left bare, but the fronts of all panels were given a coat of "Cadet Gray" auto enamel, following a primer coat of zinc chromate. The finishes were sprayed on, followed by a half-hour period of baking under heat lamps. Heat should not be applied, however, until the enamel has become set at room temperature. Needless to say, all panel drilling was completed before the paint job was undertaken.

Construction of the audio units followed normal procedure, with all major components being mounted before wiring was begun. All 60-cycle a.c., high-level audio, and d.c. wiring of any appreciable length was laced into cables which follow around in the corners of the chassis. Low-level audio leads were shielded, while all small parts such as resistors and condensers were either connected between socket terminals or mounted on lug strips. The type of octal sockets used in the speech amplifier have soldering lugs as an integral part of their mounting plates. All ground connections for any given tube were made to the lugs on that tube's respective socket.

Sockets for the 811 modulator tubes were mounted with spacers about 1½ inches below the surface of the chassis due to the height of the tubes. This permitted the vertical mounting of the 811's even with the 8¾-inch panel.

After completion of the modulator and speech amplifier, each unit was checked through with an ohmmeter as a precaution against errors. Then the two sections were mounted in a standard 26¼-inch rack cabinet, along with the 250-watt 813 r.f. section described in the previous article. Interstage wiring was laced into a cable which

Bottom view of the clipper-filter speech amplifier system. The small choke near center is in the clipper-filter circuit. Terminal strips were used liberally for precise wiring. The "professional" dress is easily achieved in this large chassis.



as run down the side of the cabinet nd secured to the wall at several oints by cable clamps.

Testing and adjustment of the cliper controls were made with the r.f. ection delivering full power to a ummy load and with an oscilloscope onnected to give an r.f. envelope attern. The output control of the lipper was set to a point somewhat elow the 100 per-cent modulation oint. Then, while speaking into the nicrophone, the input control, R_5, was dvanced until audio peaks reached point where they no longer increased n amplitude. This was the point vhere clipping was beginning. Adancing the input control beyond this etting did not increase the peak amlitude, but did bring up lower-level assages. With clipping taking place, he output control, R_{13}, was advanced ntil the oscilloscope indicated 100 er-cent modulation, as evidenced by eaks nearly reaching the zero-level ine. Under normal conditions the utput control setting does not have to e changed. The degree of clipping, owever, can be adjusted by changing he position of R_5. In the writer's rig, ormal settings for 100 per-cent moduation and about 10 db of clipping howed both input and output controls t about 11 o'clock. Input control ettings in other cases, however, may ary widely, depending upon the type f microphone used, the level of one's oice, and the distance the operator peaks from the microphone. —30—

SERVICE BENCH NOTE

By R. A. HUNHOLZ

AYTHEON MODEL C2002A

There was no sound or picture on this et and the customer complained that ie set blew ¼ amp. fuses so he had put a 6/10 amp. "Slo-Blo" unit which nmediately blew out.

We pulled out the two 6BQ6's and ie 6W4, inserted a ¼ amp. fuse and rned on the set. The sound was reored. The conclusion was that the curent requirement of the set was too high ue to a short in the high-voltage branch. esistance readings taken throughout is section revealed no shorts. A d.c. mmeter, on the 1 amp. scale, was conected to the bridge fuse mounting. An c. ammeter was used in the primary of ie power transformer. The power plug as inserted carefully in the a.c. outlet.

The set's current consumption rose to ormal on the ammeter in the primary rcuit and then as it came up to operatg temperature rose alarmingly. The c. ammeter reading also increased beond normal and short-circuit frying oises were heard in the high-voltage ge. The a.c. plug was pulled to prevent ower transformer burnout.

Brief connection was again made and hite arcing was seen inside the horintal linearity coil. This coil was reoved and upon being disassembled cing was found on the iron core and rn-through on the coil form was disvered. None of this damage was visible the outside of the coil. The iron core at ground potential and the coil windg carries boost voltage and high-freency a.c. for d.c. high-voltage generaon.

Replace the horizontal linearity coil correct this fault. —30—

MONEY MAKERS!

FOR MOBILE-RADIO SERVICE ENGINEERS!

Provide for future expansion in this profitable field, with Lampkin frequency- and modulation-measuring equipment.

For Any Number of Frequencies, AM or FM. The Type 105-B MFM.

The Type 105-B Micrometer Frequency Meter, or MFM, measures center-frequency on any number of nearby transmitters, AM or FM, 0.1 MC. to 175 MC. Performs as signal generator for mobile receivers, 20 MC. up. Meets FCC requirements for mobile services, with accuracy guaranteed better than 0.0025%. Can be checked against WWV. Price $220.00 net.

The Type 205 FM Modulation Meter for Multiple Mobile Frequencies.

Instantly tunable anywhere, 25 MC. to 200 MC., the Type 205 measures maximum FM deviation due to modulation, as required by the FCC. Indicates 0-25 KC. deviation. Simple to use, easy to carry. No charts or tables. Price $240.00 net.

Send name and address for literature

Name ....

Address ....

City .... State ....

LAMPKIN LABORATORIES, INC.
MFM DIVISION
BRADENTON, FLORIDA

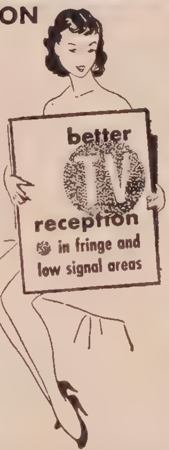
Editors and Engineers
PUBLICATIONS

BETTER TV RECEPTION

New 2nd Edition.

IT COVERS ALL YOU WANT TO KNOW ABOUT

fringe and low-signal areas



BETTER TV RECEPTION has become the standard guide for the installation technician and a popular text for TV enthusiasts.

Book No. E&E-TR2

$2.50 per copy *
(paperbound) at our store

Radiotelephone License Manual. Typical study questions with concise answers for any commercial U.S.A. radiotelephone operators license. Order Book No. E&E-RL1 ....$3.75*

Antenna Manual. A practical, comprehensive book on antennas, for everyone interested in transmission and reception. Over 300 pages. Order Book No. E&E-AM1 .... $3.50*

Radio Handbook. Giant 13th Edition. A one-volume library of radio information with extensive, simplified theory. Detailed how-to-build-it data on dozens of items of practical radio equipment. 734 pages. Order Book No. E&E-RH13....................$6.00*

Surplus Radio Conversion Manual. Volume 1. Practical conversions. Write for list of contents. Order Book No. E&E-SM1......................$2.50*

Surplus Radio Conversion Manual. Volume 2. Companion to Volume 1. Order Book No. E&E-SM2. $2.50*

*Plus any tax.

BUY FROM YOUR DISTRIBUTOR
ADD 10% ON DIRECT MAIL ORDERS TO
EDITORS and ENGINEERS, Ltd.
BOX 689A, SANTA BARBARA, CALIF.
Bookstores order from BAKER & TAYLOR, Hillside, N. J.

LEARN

Television-Radio
Electricity
REFRIGERATION-ELECTRONICS
IN THE GREAT SHOPS OF COYNE

TRAIN QUICKLY! OLDEST, BEST EQUIPPED SCHOOL of ITS KIND in U.S.

Come to the Great Shops of Coyne in Chicago. Get practical training in opportunity fields—TELEVISION-RADIO — ELECTRICITY — ELECTRONICS—vital in Defense Program. Prepare now for a better job in Industry or better service rating.

Approved for Veterans

Finance Plan—Enroll now, pay most of tuition later. If you need part-time work to help out with living expenses while at Coyne, we'll help you get it. **Special tuition plan for men of Draft Age.**

FREE BOOK Clip coupon for Big Free Illustrated Book. No salesman will call. Act NOW.

B. W. Cooke, President

COYNE SCHOOL

A TECHNICAL TRADE INSTITUTE CHARTERED NOT FOR PROFIT
Established 1899
500 S. Paulina, Chicago

ELECTRICITY ★ TELEVISION
RADIO ★ REFRIGERATION ★ ELECTRONICS

B. W. COOKE, Pres.
COYNE School
500 S. Paulina St., Chicago 12, Ill. Dept. B3-85H

Send FREE BOOK and full details on:
☐ TELEVISION-RADIO ☐ ELECTRICITY

NAME..

ADDRESS..

CITY STATE

TUBES BRAND NEW! JAN! BOXED! **TUBES**

1B22	.69c	39/44	.29c	826	.39c
1B23	$3.75	100R	.49c	841	.29c
2B22	.49c	114B	.29c	843	.17c
2C26	.09c	215A	.09c	864	.19c
2C26A	.09c	221A	.29c	1626	.19c
3B22	$1.19	316A	.29c	7193	.19c
3D6	.39c	388A	.59c	9002	.69c
7C4	.39c	471A	$1.19	E1148	.49c
10Y	.19c	532A	$1.19	RK34	.99c
12K8Y	.39c	722A	.99c	VR92	.14c
15R	.39c	801A	.19c	VT127	.15c

HEADSETS

HS-23 high impedance. BRAND NEW with ear pads	$5.95
HS-33 low impedance. BRAND NEW with ear pads, cord and PL54 plug	6.45
HS-33—BRAND NEW—Western Electric	7.25
CD-307A Cords. 6 ft. NEW	$1.49
H-16/U high impedance. Includes two receiving units	3.95
HS-16 high impedance—used	.98

SCR-274N COMMAND and ARC-5 EQUIPMENT

RECEIVERS	USED	EXCELLENT USED	NEW
BC-453—190 to 550 KC	$29.95		$49.95
BC-454—3 to 6 MC			24.95
BC-455—6 to 9 MC		$13.95	19.95
1.5 to 3			34.95
TRANSMITTERS			
A-958—2.1 to 3 MC			29.95
BC-457—4 to 5.3 MC		14.95	
BC-458—5.3 to 7 MC		14.95	29.95
ARC5-T-19—3 to 4 MC		24.95	34.95
BC-459—7 to 9.1 MC			24.95
T-15 ARC 5—500 to 800 KC			29.95
ADDITIONAL EQUIPMENT			
BC-456 Modulator			7.29
BC-450 Control Box (3 Receiver)	1.49	1.95	2.75
BC-451 Control Box (Transmitter)	1.29	1.79	2.39
BC-442 Relay Unit (ANT)			5.69
Plugs: PL-147, 148, 151, 152, 153, 154, 156—EACH		1.25	
Flexible Shafting with gear to fit receivers			2.69
3 Receiver Rack	1.79	2.29	2.98
2 Transmitter Rack	1.69	2.39	3.97
Single Transmitter Rack			3.97
DM-33 Dynamotor for Command Set.		2.95	3.95
Mounts for Above Racks		1.95	

ARMY TEST UNIT 1-236

Meter is contained in a metal box 5½" long x 3¾" wide x 3¼" deep. Comes complete with test leads and instruction book. Can be used for testing between AC and DC measuring resistance of circuits, checking fuses and testing capacitors.

SPECIAL **$4.19**

FIELD TELEPHONES

Army surplus, completely reconditioned and electrically tested, using 2 flashlight cells and a pair of interconnecting wires. GUARANTEED.

New $28.95. LIKE NEW **$22.95**

20 POUNDS OF ASSORTED RADIO PARTS

A TERRIFIC BUY AT ONLY..... **$2.79**

TURBO AMPLIFIER

4 tube Amplifier used by U. S. Air Force. 115 V. input at 400 cycles. Without tubes—EXCELLENT.

SPECIAL **$1.19**

ARC-5/R-28 2 MTR RCVR

$25.95

Here is the 2-meter superhet you have been looking for! Absolutely one of the BEST available today! Tunes from 100 to 156 Mcs. in four crystal channels. (Easily converted to continuous tuning.) Tube lineup is as follows:
717A—R.F., 717A—Mixer, 2-12SH7—1st and 2nd I.F. 16.9 Mc.
12SL7—Det. AVC Spuelch, 12SL7—1st audio-spuelch amplifier.
12A6—2nd audio, 12SH7—R.F. Osc.—4th Harmonic Gen.
717A—Trip. 12th Harmonic Gen. 717A—Dblr.—12th Harmonic.
Excellent, used $25.95

BE SURE TO VISIT PLATT'S BRANCH STORE at 159 GREENWICH ST., N.Y.C. (just off Cortlandt St.). You'll find many bargains that space does not allow us to list here.

MINIMUM ORDER $2.00

Immediate Delivery—Send 25% deposit on C.O.D. orders. All shipments F.O.B., N.Y.C. (N.Y.C. residents add sales tax to your remittance.)

PLATT ELECTRONICS CORP.

Dept. A. 489 Broome St., N. Y. 13, N. Y.
PHONES: WO 4-0827 and WO 4-0828
BRANCH STORE: 159 Greenwich St., N.Y.C.

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

THE recent convention sponsored by the Television Service Engineers of Greater Kansas City, Inc., and billed as the national convention of the Television, Radio and Electronics Servicing Industry under the auspices of NATESA, was presented with a professional touch that was a credit to the officers of TSE who managed it.

Perhaps the most significant feature of this service convention was that the service businessmen who attended it paid a $10.00 registration fee. This bespeaks of a recognition of individual responsibility on the part of businessmen in service that is somewhat new to the activity of servicing. It adds a dignity to the business of servicing that men engaged in it are willing and able to "pay their own freight" in financing programs that are of vital interest to them.

True, those who attended the Kansas City convention got a swell package of information and entertainment for their ten dollar registration fee. They heard a series of intensely interesting and informative talks given by men who know service industry problems; they were treated to a dinner, a luncheon, and a banquet topped off by an excellent floor show; and they were able to examine a wide range of the latest products of service interest in the exhibition hall.

It was a *service managed* show. TSE had the whole-hearted support and cooperation of all local electronic parts distributors and most of the manufacturers' representatives who operate out of Kansas City. All arrangements for the affair were handled by a professional public relations expert.

Service business and technical talks were given by John Thompson, *General Electric Company;* Lee Allen, *American Phenolic Corp.;* Frank Mansfield, *Sylvania Electric Products Inc.;* Lloyd Austin, *Simpson Electric Co.;* Harold Rieth, *Regency* division of *I.D.E.A. Inc.;* Robert Artman of the *Empire Coil Co.;* Larry Kearney, *La Pointe Electronics Inc.;* and Chet Jur, *Merit Coil & Transformer Corp.*

Al Saunders, nationally known lecturer on TV servicing and director of the *Saunders Radio & Electronic School* of Boston, Mass., delivered two major talks. At the banquet he spoke on "Service Progress Through Co-operation" and on the last day of the convention he discussed "Service Education." L. B. Calamaras, executive

The main auditorium of the Deming Hotel in Terre Haute, Ind., was filled to capacity by TV technicians from Indiana and Illinois who came to hear Edward M. Noll present his TTLB lecture on u.h.f. television. Sponsored by Archer & Evinger, parts distributing firm of Terre Haute, the lecture attracted technicians from towns in a radius of 150 miles.

vice-president of the National Electronic Distributors Association spoke on "Service Licensing."

Frank Moch, president of NATESA, presented association awards to John Thompson of the *General Electric Company,* Neal Hunter of *Sprague Products Company* and Frank Mansfield of *Sylvania Electric Products Inc.,* for their companies' public relations programs on behalf of the independent service industry.

Television Service Engineers of Greater Kansas City comprises twenty-eight member firms who operate in that metropolitan trade area. Present officers are Albert A. Richards, president; J. B. McDowell, vice-president; Ray Crawford, secretary; Robert Hester, treasurer; and M. D. Thompson, sergeant-at-arms.

Predictions—and a Credo

David Sarnoff, chairman of the board of *Radio Corporation of America,* painted a glowing picture of the future of TV and radio, of u.h.f., of color TV, and the electronics field in general in his keynote address at the NARTB convention in Los Angeles.

Of u.h.f., he said, "Developments now under way will enlarge the coverage and improve the quality of the u.h.f. signal. New antenna systems will increase efficiency of u.h.f. transmission and control the broadcast energy so that the signal can be directed into valleys within the coverage pattern. There is no doubt that operations in u.h.f.—'the band of the future'—will fill a place of growing significance in television."

On the subject of color television, Mr. Sarnoff pointed to the recent highly successful demonstrations of compatible color television as proof that it was technically ready for submission to the FCC for review and decision. He predicted that perhaps a half million color television receivers could be produced within three years after the Commission establishes commercial compatible color television standards.

Woven into the fabric of Mr. Sarnoff's address was a moral challenge to all industry elements to fulfill all responsibilities of service to the public.

"Radio was built on the basis of service to the American people. Television must be based on the same solid foundation. For all its drama and potential for profit, television should be no place for get-rich-quick Wallingfords, more interested in what they can take than what they can give.

"Sure, they may ride high for a time, but they will have no staying power. Sooner or later, the public will intervene, and they will lose out to broadcasters who have shouldered the responsibilities on which continuing opportunities for profit are founded.

"Television, like radio, should be a profession, with all that term best implies in integrity, dignity, and above all dedication to a tradition of pub-

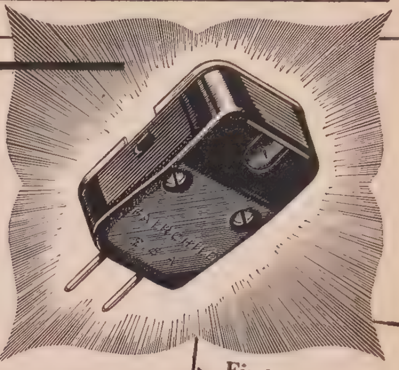
NOW...PROFESSIONAL QUALITY SOUND REPRODUCTION RIGHT IN YOUR OWN HOME!

THE AMAZING NEW

FAIRCHILD

SERIES 215

DIAMOND CARTRIDGE



First to achieve near-perfect lateral compliance for optimum Hi-Fi performance...

With finest diamond stylus for 33, 45 or 78 rpm records

NOW ONLY $37.50

Replace any modern pickup with this new cartridge, and enjoy recorded music as never before! *High compliance* — freedom of stylus to yield to rapid lateral deflections — provides these exciting improvements:

- *New shades of tone color from fine recordings!*
- *New clear timbre in high volume piano chords!*
- *Rich low-frequency tones never previously heard!*
- *Arm resonance, "needle talk," rendered inaudible!*
- *Stylus wear greatly reduced, record quality preserved!*
- *And above all — TRACKING DISTORTION ELIMINATED!*

High compliance, low-mass stylus assembly and smooth linearity of extended range are *exclusive features* of the new Fairchild 215.

ORDER FROM YOUR AUDIO DEALER—*or write direct to:*

FAIRCHILD RECORDING & EQUIPMENT CO.

8th Ave. & 154th St., Whitestone, N. Y.

Manufacturers of the World's Finest Professional Sound Equipment

ELL ON DEMONSTRATION THE *New* DuKANE *Tru-Fidelity* TAPE RECORDER

THE FINEST IN TRU-FIDELITY RECORDING

SELLS READILY AT $299.50

(SLIGHTLY HIGHER WEST OF ROCKIES)

DEALERSHIP AVAILABLE *NOW!*

MAIL COUPON FOR INFORMATION TODAY!

DUKANE CORP. Dept. RTN-73 St. Charles, Ill.

☐ Send details on the new DuKane Tru-Fidelity Tape Recorder.

☐ I am interested in a dealership.

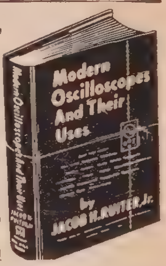
Name__________

Address__________

City__________ State__________

ESTABLISHED AS "OPERADIO" 1922

NOW! YOU'LL REALLY KNOW HOW TO USE OSCILLOSCOPES!



Here, at last, is a practical book that makes it easy for you to learn to use the oscilloscope FULLY on all types of AM, FM and TV service work — and dozens of other applications. MODERN OSCILLOSCOPES AND THEIR USES, by Jacob H. Ruiter, Jr., of Allen B. DuMont Labs contains 326 fact-jammed pages of just the help you need —written so you can easily understand it. The book shows exactly how the 'scope works; how to use it on all service jobs from trouble-shooting to realigning; how to make connections; how to adjust circuit components; how to set controls and how to analyze patterns. 370 illustrations including pattern photos make things doubly clear.

When, where, why and exactly how to use your 'scope.

•

How to interpret patterns.

•

How to handle tough jobs in less time.

PRACTICE FROM IT 10 DAYS

at our risk!

Dept. RN-73, RINEHART BOOKS, Inc.,
Technical Division,
232 Madison Ave., New York 16, N. Y.

Send MODERN OSCILLOSCOPES AND THEIR USES for 10-day FREE EXAMINATION. If I decide to keep the book, I will then remit $6.00 plus a few cents postage in full payment. If not, I will return book postpaid and owe you nothing.

NAME..........

ADDRESS..........

CITY.......... ZONE... STATE......

OUTSIDE U.S.A.—Price $6.50 cash with order. Money back if book is returned in 10 days.

TELEPHONES

DESK TYPE PHONE, IDEAL FOR PRIVATE—INTERCOM, AMATEUR MIKE, ETC. USES HI-QUALITY CARBON TRANSMITTER, POWERFUL MAGNETIC RECEIVER. A GREAT, ONCE-IN-A-LIFETIME VALUE. AS SHOWN.......... $3.50
RINGER BOXES FOR ABOVE, WOOD CASE 3.00
RINGER BOXES FOR ABOVE, METAL CASE 5.00

DYNAMOTORS

ALL BRAND NEW—ORIGINAL PACKING

	INPUT		OUTPUT		
TYPE	VOLTS	AMPS	VOLTS	AMPS	PRICE
PE 86	28	1.25	250	.060	$4.25
DM 416	14	6.2	330	.170	6.75
DM 33A	28	7	540	.250	3.95
BD AR 93	28	3.25	375	.150	7.50
23350	27	1.75	285	.075	3.95
B-19 Pack	12	9.4	275	.110	8.95
			500	.050	
DA-3A*	28	10	300	.260	6.95
			150	.010	
			14.5	5.	
5053	28	14	250	.060	3.95
PE 73 CM**	28	19	1000	.350	
337	14	8	425	.160	7.95

* Replacement for PE 94.
** Price sent on request.

INVERTERS

PE-218-H: Input: 25/28 vdc, 92 amp. Output: 115 v, 350/500 cy 1500 volt-amperes. New.....$44.50

PE-206: Input: 28 vdc, 38 amps. Output: 80 v 800 cy, 500 volt-amps. Dim: 13"x5½"x10½". New..............................$22.50

VIBROPACK, MALLORY TYPE G-556. INPUT 12 VDC. OUT.: 225/250/275/300 VDC @ 100 MA. Brand New with 2 spare vibrators......................$12.50

VIBRATOR, TR 1210, FOR USE IN INDUSTRIAL INVERTERS DELIVERING 115 VAC @ 100 WATTS FROM 12 VDC..1.69

MOBILES! C. D. MEN! CAP!!

IDEAL DYNAMOTOR — CONVERTS EASILY TO SUPPLY UNIT DELIVERING

12 VOLT INPUT
610 V @ 150 MA
325V @ 125 MA

OR

6 VOLT INPUT
300V @ 90 MA
160V @ 110 MA

BRAND NEW WITH CONVERSION DATA $3.75

BAND PASS FILTERS

INPUT IMPEDANCE: 2000 OHMS. OUTPUT: TO GRID. AVAILABLE IN FOLLOWING RANGES:

CHANNEL	Fr.	F1*	F2*
5	1155	830	1620
7	2270	1620	3180
8	3180	2270	4450
9	4450	3180	6230
10	6230	4450	8720

* Fr.: Center Freq. in CPS; F1 and F2 are lower and upper limits (CPS) respectively, at —20 db points.
Size 1¾" diam. x 4" L..........Price, $4.95 Each

JAN/UG CONNECTORS

UG 9/U	$0.85	UG 58/U	$0.70
UG 10/U	.95	UG 89/U	1.05
UG 21/U	.80	UG 102/U	.75
UG 22B/U	1.25	UG 188/U	1.15
UG 22/U	1.20	UG 254/U	2.50
UG 27/U	1.20	UG 261/U	1.10
UG 27A/U	2.25	D-166366	.75

GN 35 Hand Generators

BRAND NEW, IN ORIGINAL CARTONS. WILL DELIVER 8 V @ 2.5A AND 325-365 V @ 100 MA OR 10 V 1.25A AND 380-420 V @ 70 MA. LESS HAND CRANKS. A GREAT VALUE $17.50

H.V. FILAMENT XFMR

NO. FT-38A—
PRIMARY: 115V 60 CY. 1 PH.
SEC.: 2 WDGS. 2.5V AT 7 AMPS EACH, AND 1 WDG. 6.3V @ 2.5A TESTED AT 7500 VDC BETWEEN ALL POINTS.
HERM. SEALED. SIZE: 5½" H x 3½" D x 4" W. HAS 4 STUDS, ½" L on 2⅞" x 3" CENTERS.
AS SHOWN................ $2.79

SELENIUM RECTIFIERS*

Current (Continuous)	18/14 Volts	36/28 Volts	54/42 Volts	130/100 Volts
1 Amp.	$1.25	$2.10	$3.60	$7.50
2 Amps.	2.20	3.60	6.50	10.50
2½ Amps.	....	....	....	13.00
4 Amps.	3.75	....	8.75	....
5 Amps.	4.95	7.95	12.95	27.00
6 Amps.	5.50	9.00	14.00	33.00
10 Amps.	6.75	12.00	20.00	40.00
12 Amps.	8.50	16.00	25.50	50.00
20 Amps.	13.25	24.00	36.00	90.00
24 Amps.	16.00	31.00	39.50	98.00
30 Amps.	18.50	36.00	* FULL-WAVE	
36 Amps.	25.50	45.00	BRIDGE TYPES	

Send M.O. or Check. Shipping Chgs. C.O.D.

COMMUNICATIONS EQUIPMENT CO.
131 Liberty St. Dept. N-7. New York City 7, N. Y.

lic usefulness. It should provide careers upon which young Americans can enter with the same proud sense of fulfilling a vital public function that they have in entering science, medicine, law, or journalism. That inner awareness of mission applies not only to stations and networks but to TV performers, production people, administrators, salesmen, and technicians."

In concluding his address Mr. Sarnoff epitomized over-all industry responsibility in preserving the elements of our way of life:

"In the final checkup, the amazing history of our industry, its record of consistent growth and success, are end products of the American system of free economy. They represent not merely triumphs of electronics but triumphs of America. It is the magic of freedom that gives full play to all the energies and talents in our economy; that strikes a fruitful balance between competition and cooperation; that blends the motive power of self-interest and public interest to enrich the life of the individual citizen and the vitality of the nation as a whole.

"The price of that freedom has ever been restraint and self-discipline, as well as a strong sense of personal and group responsibility. Nowhere is the payment of this price more essential than in an industry like ours, using public channels and concerned with the needs, the well-being, the happiness, and moral health of the entire population."

Good Business Sense

Harry B. Price, Jr., of Norfolk, Va., has built one of the country's foremost television and appliance retail businesses. As president of *Prices, Inc.,* operating three stores in Norfolk, he has built an organization that consistently produces more than a million dollars worth of business a year from hard selling and fair dealing. As an active and hard-working vice-president in the National Appliance & Radio-TV Dealers Association, he has helped hundreds of fellow appliance dealers through his frank discussions of the business policies that have been responsible for the signal success of his organization.

Since the elements of success are the same in the operation of a radio-TV servicing business as in television and appliance retailing, service executives are finding it profitable to study Mr. Price's business operating observations. In a recent letter to the Appliance Dealer's Association of Greater Cincinnati he asked them a forthright question—"What kind of a dealer are you?"

"Dealers have a great decision," he said in his letter. "You must make up your mind as to what kind of a dealer you want to be. You must decide whether you will strive to be a positive contributing influence in this industry or whether you will be content in remaining or becoming a 'parasite.'

CRYSTALS! LOWEST PRICES!

ONLY 79¢ EA.

ACT NOW

In FT 241-A Holders—½ in. Pin SPC. These are designated 54th or 72nd Harmonic MC freq. •Listed by fundamental freq. with fractions omitted.

370 372 374 375 376 377 379 380 381 383 384 385 386 387 388 390 391 392
393 394 395 396 397 398 400 401 402 403 404 405 406 407 408 409 411 412
413 414 415 416 418 419 420 422 423 424 425 426 427 429 430 431 433 434
435 436 437 438 440 441 442 443 444 445 446 447 448 450 451 452 453 454
455 456 457 458 459 461 462 463 464 465 466 468 469 470 472 473 474 475
476 477 479 480 481 483 484 485 486 487 488 490 491 492 493 494 495 496
497 498 501 502 503 504 505 506 507 508 509 511 512 513 514 515 516

5 CRYSTALS.....................Assorted ONLY $2.75
10 for $4.50; 20 for $8.50
COMPLETE SET!!!!!—80 crystals covering above basic freq. including a 500 Kc. crystal....All for $16.50

SPECIAL 500 Kc. Crystal $1.25
200 Kc. Crystal 2.25
1000 Kc Crystal 3.25

All above crystals sent postpaid. Also available in complete sets for SCR-608, SCR-528, SCR-628, and TRC, Foreign, wholesale, and dealer inquiries invited. Write for LARGE QUANTITY DISCOUNTS.

ARC-5 OR 274-N TRANSMITTERS

2.1-3 mcs. Brand new...............$19.95
4-5.3 mcs. With tubes............... 6.95
5.3-7 mcs. With tubes............... 6.95
7-9.1 With tubes...................... 14.50

ARC-5 OR 274-N RECEIVERS

Equipped with tuning knobs

.19-.55 kc. $19.95
1.5-3 mcs. Brand new.............. 24.50
3-6 mcs. Less tubes................ 6.95
3-6 mcs. With tubes................ 10.95
6-9.1 mcs. With tubes. Used....... 10.95
New 22.50
6-9.1 mcs. Used. Less tubes....... 8.95
MD-7 ARC-5 PLATE MODULATOR. Excel. cond. 14.95
BC-456 274-N Modulator. Less dynamotor. Excel. cond. 3.95
12 V. COMMAND RECEIVER DYNAMOTOR. New 12.95
Plus All Accessories Needed for Above.

AIRCRAFT, HAMS & MARINE MEN!

SCR-183 12 V. RECEIVER & TRANSMITTER! Covers aircraft, marine and ham bands! Complete with coils, control boxes, tuning head, flex cable, rack and shock mount! Individual parts worth $25.35. This month slash-price special...........$15.95

MARINE EQUIPMENT

COLUMBIA'S NEWEST HI-POWERED 1953 MARINE TRANSMITTER. Puts out max. power allowed by F.C.C. Contains all latest improvements & meets newest F.C.C. specs. Specify whether 12 or 24 V., frequency desired, and positive or negative ground. Full 90-day, unconditional guarantee. Pre-tuned, ready to install.....................$349.50

BC-223 25 W. TRANSMITTER & ARB RECEIVER: For 24 V. inst. Receiver covers beacon, standard, and b'cast marine frequencies and amateur bands. This combo makes the finest LOW-COST marine installation on the market. Complete, checked out, ready to go. The whole deal ONLY.....$185.00 Write in for conversion info for 12 V. inst.

DU-1 LOOP makes ARB RECEIVER one of the best radio compass units made. With conversion dope. Used cond. $32.50

JEFFERSON-TRAVIS MARINE 5 W. RADIOTELEPHONE: Made by Emerson Radio Corp. 2-channel, crystal controlled receiver & transmitter. F.B. for small boats with 6 V. system or sail boat. Will run 48 hrs. on standard 6V. car battery. Complete with tubes, instructions, but less crystals and battery. NEW $79.50
Above unit with 110 V. charger for 6V. battery. NEW $89.50

CRYSTALS FOR ABOVE: Specify freq. Set of 4 needed. Per Set...............$22.50

P.S. Send for our NEW, FREE CATALOGUE! At same time tell us what new or used radio gear you have to sell. We pay TOP $$$!

All orders F.O.B. Los Angeles. 25% deposit required. All items subject to prior sale.

COLUMBIA ELECTRONIC SALES
522 South San Pedro St. Los Angeles 13, Calif.

Unlimited Opportunities in

RADIO ENGINEERING

DEGREE IN 27 MONTHS

Complete Radio Engineering course, including Telev., U.H.F. and F.M. Bachelor of Science Degree also in Mech., Civil, Elect., Chem., and Aero. Eng.; Bus. Adm., Acct. Extensive campus, modern buildings, well equipped labs. Low cost. Prep courses. Personalized, practical instruction. Founded 1884. Placement service. Growing shortage of engineers. Prepare now for unlimited opportunities ahead. Approved for Korean vets. **Enter September, January, March, June. Write for catalog.**

TRI-STATE COLLEGE
1673 College Avenue, ANGOLA, INDIANA

"You must decide whether this usiness is worth the long pull, justi-ying sound policies of operation, with e knowledge that all good things emand some sacrifices and that the timate rewards and the satisfaction accomplishment make the struggle orthwhile. Or you can decide to ake what the immediate offers and rget about tomorrow or next year. hat attitude makes you a parasite.

"Webster's dictionary defines a arasite as, 'A useless person doing o work but living in comfort at the xpense of others.' That describes too any dealers today who are getting hat volume they enjoy through the rocess of selling merchandise at a rice. Sometimes at a price of only 10.00 above cost, on the premise that ny sale is better than no sale. They re living off a market created by e money, sweat, and heartaches of any organizations and individuals at preceded them. They work little nd contribute nothing. They represent a serious threat to our way of fe.

"Look around you at the monuments to sound operation and constructive thinking," his letter continued. "Successful retailers in all lines e those who have built a reputation r fair values, the same treatment of l customers, and good service after e sale was made. *Develop a philosophy of operation or a creed.* Make ur store a good place in which to end money. Make your organization good place in which to work. Make ur group an asset to the community. Build stature through fair dealg and profits through intelligent peration. Be fair with suppliers—en you will be in a position to deand equitable and intelligent treatent from them.

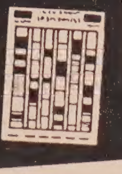
"The recent failures of dealers who ve seemingly done a satisfactory lume of business should be a warng. I list some of the reasons for solvency:

1. Inadequate capital for size of siness.
2. Unintelligent buying.
3. Failure to recognize the breaken point and adjust overhead when lume drops.
4. Failure to develop loyal, competnt employees.
5. Failure to build joint respect and operation with suppliers.
6. Carrying too many lines.
7. Lack of planning and a complete sunderstanding of, or ability to, prote and advertise.
8. Indifference and just plain laziss.
9. Not getting the profit on sales—her giving it away in discount or large trade-in allowance.
10. Too much investment in trade-.

"Take the matter of planning. If ı don't plan how do you know how ch to spend for advertising, for exple? How do you develop a bud-? How do you establish your ak-even point?

ORDER BY MAIL FROM "WHOLESALE RADIO"

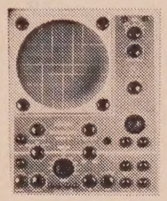
GET YOURS FREE!
COMPLETE '53 SPECTRUM FCC FREQUENCY ALLOCATIONS
- COMPLETE ALLOCATIONS OF ENTIRE BAND: 100 KC to 100,000 MEGS.
- EASY TO READ COLOR CHART
- A MUST FOR ENGINEERS, HAMS, SERVICEMEN AND EXPERIMENTORS



FREE! At Wholesale Radio Parts Co. Inc.
BY MAIL: enclose 10 cents to cover postage and handling cost.

Immediate Delivery!

PRECISE 300 K 7″ SCOPE KIT



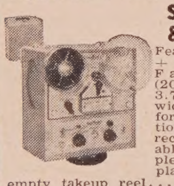
Sensitivity—Less than 10 mv.
Has true electronic sweep magnifier. Astigmatism control. Push-pull vertical from input thru output; push-pull horizontal. Internal blanking and Z modulation with blanking amplifier. Driven and non-driven sweep. Over 5 MC flat response (3 db.) DC amplifiers. Cathode follower input on vert. and horiz. Internal calibrator. Horiz. and vert. stepping attenuator. NEW 7″ tube. Highest sensitivity. COMPLETE WITH ALL TUBES, HARDWARE AND STEP-BY-STEP CONSTRUCTION BOOK.
MODEL 300 K $94.95

More Famous PRECISE Kits!
630K RF-AF-TV & MARKER GENERATOR KIT..$33.95
(630KA pre-assembled head $38.95) (630W wired ....$53.95)
635K UNIVERSAL AF SINE, SQUARE & PULSE GENERATOR KIT $33.50
(635 wired ....$52.50)
610K RF SIGNAL GENERATOR KIT..........$23.95
(610KA pre-assembled head $28.95) (610 wired $39.95)
907K VTVM KIT WITH 7½″ METER..........$38.98
(907 wired ....$57.98)

Check Pix Tube Circuits on-the-Spot

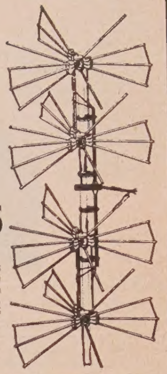
New! RMS PIX-EYE $5.97
Eliminates time, labor and danger of unnecessary removal of picture tube. Makes instant checks of brightness control, video, contrast control, low voltage and filament voltage circuits.

NEW PT-150 TAPEMASTER
PORTABLE DUAL SPEED TAPE RECORDER
Self-Contained Speaker & Amplifier in 1 Unit!



Features—Freq. Resp.: 50-8000 cps. ± 3 db at 7.5 and 50-5000 at 3.75. Fast forward and rewind speed (20:1 ratio). Dual speed: 7.5 & 3.75 in. per sec. Dual track: ¼″ width tape—manual reversal. Inputs for radio, phono and mike. Equalization high and low compensation for record and play. Hi-fidelity for portable use or custom installation. Complete with microphone, 5″ spool plastic tape and 7″ empty takeup reel.......... $124.50

Equal to $100 TV Aerial Systems
360° SUPER DIRECTRONIC
Electronically Rotates in All Directions



Exclusive Snyder Engineering and Design cuts cost to.......... $44.95
Especially for ultra-fringe areas where signals arrive from more than one direction. Extra high gain over any other broadband aerial. No motors or electric power. 48 elements. COMPLETE WITH 6-POSITION DIRECTRONIC BEAM SELECTOR, 150′ TUBULAR TRI-X CABLE, UNIVERSAL U CLAMPS. Order Snyder Model AX 548.

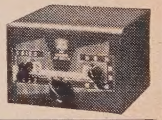
Model AX524—Same Directronic operation as AX-548. 2 bay, 24 elements. Complete with 6 pos. sw., 100 ft. tubular cable, 3 matched stacking bars. U clamps.......... $24.95

RESISTOR & CONDENSER BARGAINS
100 ASS'T RESISTORS. ½-1-2 W..........$1.95
50 ASS'T MICA COND. 5mmf to .001 mf.. 1.95

Why Waste Time Waiting for Test Pattern
RMS TV BAR GENERATOR
Makes Actual Bars on Any TV Screen
Make accurate, on-the-spot linearity adjustments. No chassis removal necessary. Operates directly into ant. terminals. Adj. number of horiz. & vert. bars. Complete unit. Order RMS BAR-1. $14.95

PIC TUBE BRIGHTENER $1.49
Gives new life to old pic. tubes. For use in parallel filament circuits. Model P5

SUTCO UHF CONVERTER & VHF BOOSTER IN 1 UNIT
Enables any TV now being made to receive UHF and also boost VHF in fringe area. Has own power supply, a crystal mixer, a 6AF4 and a 6J6. Booster has 75-300 ohm input and output. Operates on 110-125 V AC. Terminals for UHF & VHF antennas. Model 21A.......... $35.70



SPECIAL! PRICES SMASHED!
Westinghouse Gamma Counter Tubes
Was $50. Alpha, Beta and Gamma Counter tubes. Self-quenching. #5979/BS-1 .... $8.95
Was $35. Gamma Counter tubes. Self-quenching. #5980/BS-2.......... $4.95

FREE! Write for new value-packed "FYI" bulletin #107. Write for our big audio guide, "Hi-fidelity Magic."

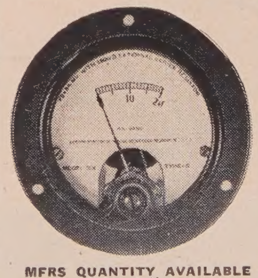
WHOLESALE RADIO PARTS CO., Inc.
311 W. BALTIMORE ST., BALTIMORE 1, MD.

AC-DC MUSIC AMPLIFIER

Volume and tone control.
1.5 w. output.
See your jobber.
MICHEL MFG. CO.
227 N. Water St.
Milwaukee 2, Wis.

RCA INSTITUTES, INC.
A service of Radio Corporation of America
350 West 4th St., New York 14, N. Y.
OFFERS COURSES IN ALL TECHNICAL PHASES OF RADIO, TELEVISION, ELECTRONICS
Approved for Veterans
Write Dept. RN-53 for Catalog

BRAND NEW • FULLY GUARANTEED
SENSITIVE MICROAMMETER



WESTON 301
Original
Weston
Boxes
0-20 Micro-amps DC

3½″ Round Flush Mount Bakelite Mfd. for Test Set TS62—No. KS9490
$9.95 EACH FOBNY
Rated Accounts 10 Days. Others 25% with Order. Balance COD

MFRS QUANTITY AVAILABLE
Spot Delivery
"An" Inspected & Approved

GREENWICH Sales Company
59 Cortlandt St., N. Y. 7
Digby 9-3813

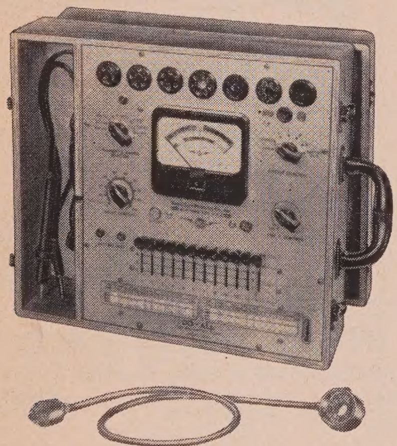
1=4

with

RCP

MODEL 324

Because the Radio City Products Model 324 "DO-ALL" Tube and Battery Tester packs into one instrument the performance of four.



. . . Sufficient Facilities to Test

1. All TV and Radio Tubes
Sockets for all standard 4,5,6,7, octal, loctal, miniature and subminiature are provided. Tests transmitting, hearing aid, ballast, pilot light, gaseous rectifiers and tuning indicator types. All readings are indicated on a large easily read meter.

2. Cathode Ray Tubes
Checks all magnetic deflection types right in the set or carton. Will locate and isolate all shorts or leaks.

3. Batteries
Tests popular portable battery types under load. Indicates true condition of battery under check.

4. All This and a Reactivator Too
Gives extra life to otherwise dim or bad picture tubes.

Adds a professional note to any service bench or store counter. Available in both counter and portable models, complete with CR Tube Adapter Cable.
Two Styles To Meet Your Service Needs—

Model 324C—Counter model with open style metal case. Size: 13¾" x 12¼" x 4". Weight: 10 lbs. Price: **$69.95**

Model 324P—Combination portable—counter model. Smart looking, hand-rubbed carrying case with slip-hinge cover—includes battery test leads. Size: 16¼" x 14¼" x 5". Weight: 12 lbs. Price: **$79.50**

Remember You Can Do More With A "DO-ALL"
See It at Your Parts Distributor
Write Dept. RN-7 for RCP '53 Catalogue.

RADIO CITY PRODUCTS CO., INC.
152 West 25th Street RCP New York 1, N. Y.

"There is a better day coming and the ones of us who operate our businesses intelligently—make a profit—justify our existence through service to our customers . . . will benefit from a growing market and profit possibilities. We will have to earn our rightful place in the market I envision by loving our work, believing in our industry, and working hard. We can join together in NARDA for the exchange of know-how, techniques and ideas, and hasten to relieve the practices that will and must go."

Summer Service Slumps

This is the time of the year when service businesses that have been managed on a day-to-day basis really begin to feel the pinch of less money from reduced volume of business. Service operators who were too busy during the Fall and Winter months to think of long-range promotions and ways and means of cushioning the sag in business that normally occurs at this time of the year, are starting to worry about how they are going to weather the summer months.

Last year, of course, interest in what was happening at the political conventions boomed the service business during the period when normally it is at its lowest ebb. It has been heartening to observe how many service executives, seasoned by experience in previous slumps, took advantage of the succeeding eight months of good business to provide for fill-in volume during this summer when they knew business would be off. None of these organizations will have big, unpaid accounts with their parts jobbers to sweat out during the Summer in the hope that the early Fall business will take them off the hook.

Many organizations have promotional programs already underway for radio and record player service. Summertime is relaxation time during which the average person drifts away from his normal living routine. Many will take a "vacation" from television and go back to radio and record listening. In radio days they took a vacation from normal radio listening because that was their main entertainment medium during the winter months. Now that television is the basic entertainment medium in TV homes, radio and record listening will provide the summertime change that most people seek.

Other organizations have prepared to handle low-voltage house wiring, or air conditioner installation and maintenance, or electronically operated garage doors as a fill-in for the normal seasonal slump in television servicing. But whatever vehicle these organizations selected to cushion the normal drop in volume, *planning* for it was started months and months ago.

Service Business Management

All set manufacturers are vitally interested in the development of strong, technically qualified, intelligently managed independent service organizations in every city, town, and village across the country. Many of them are spending substantial amounts of money to determine what it takes to operate an electronic service business profitably and are passing the results of their findings along to the service industry.

Russ Hanson of *Motorola,* for instance, advises service operators to plan technicians' time so the business will average $50 per-day-per-skilled technician. He also cautions not to let payrolls exceed 40% of gross sales. He urges service executives to work on the basis of monthly budgets with real cost records and to keep records of service requests, jobs completed, payroll and productivity of each man, backlog of work, and how long each job was in the shop and why.

In their conversations with successful service business executives in all sections of the country your editors have found that in the top businesses management *knows* volume, productivity, costs, and gross profit either daily or weekly. Most of them have programs all planned to jack up volume when business drops.

Management Planning

Dan Creato, vice-president of th
RCA Service Company, recently out
lined the basics for successful servic
business management in a talk give
before the Allied Technicians Asso
ciation of West Collingswood, N. J

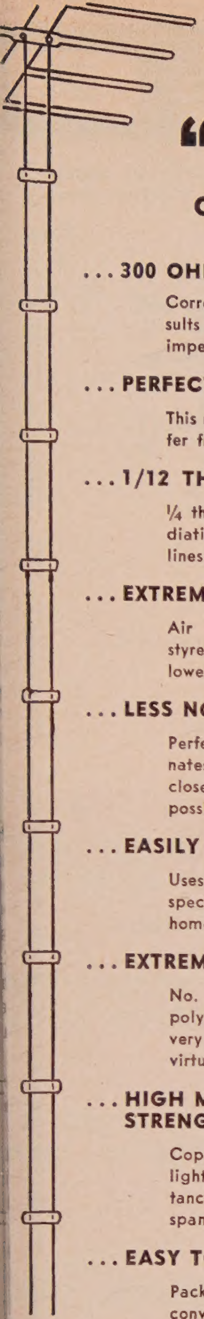
"Television servicing can be highl
profitable," he said, "but only if ef
ficient technical service is combine
with good business management.

"The palmy days of 1946 are ove
The desperate shortage of traine
technicians has improved. People n
longer find it necessary to pick jus
any kind of television service. The
have been conditioned to demand an
expect the best.

"When I say that people demand an
expect the best, I say it without re
gard to the size of the servicing o
ganization. And when I say that a
efficient operation is essential, I mea
it for the small shop as well as fo
the larger service business. The cu
tomer expects the same good servic
from both. And each can go brok
just as easily as the other without a
efficient operation."

Mr. Creato pointed out the vit
necessity for *planning*—"a man doesn
get far unless he knows where he
going"—and outlined the elements
good service business planning. H
stressed the necessity for setting u
an operating budget and detailed th
elements that must be included in th
basic blueprint of service manag
ment.

In discussing technician training
pointed out that no technician can
expert in servicing all makes of se
He said, "If a service organizati
establishes a policy of servicing a
makes of sets, it must be prepared
accept the responsibility of traini
its technical personnel in the bas



FOR VHF UHF TV INSTALLATIONS

LOW LOSS 300 OHM

"LL300"

OPEN WIRE LINE

PATENT APPLIED FOR

. . . 300 OHMS IMPEDANCE

Correct size wire and spacing results in 300 ohms characteristic impedance.

. . . PERFECT IMPEDANCE MATCH

This means maximum signal transfer from the antenna to set.

. . . 1/12 THE RADIATION LOSS

¼ the spacing means 1/12 the radiation loss of 450 ohm open wire lines.

. . . EXTREMELY LOW LOSS

Air dielectric plus clear polystyrene spacers results in the lowest possible loss of signal.

. . . LESS NOISE PICKUP

Perfect impedance match eliminates standing waves—this plus close spacing results in the lowest possible noise pickup.

. . . EASILY INSTALLED

Uses conventional stand-offs—no special hardware needed. Enters home through ½" hole.

. . . EXTREMELY LONG LIFE

No. 18 copperweld conductors, polystyrene spaces combined with very low wind resistance means virtually indefinite life.

. . . HIGH MECHANICAL STRENGTH

Copperweld construction plus light weight and low wind resistance make 200' unsupported spans possible.

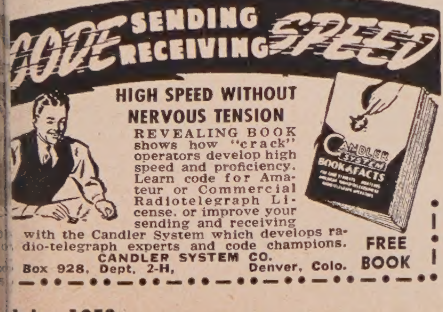
. . . EASY TO USE SPOOLS

Packaged on 100, 150, 200, 250' convenient, easy to use spools.

All the above features mean: BETTER RECEPTION—LONG LIFE—EASE OF INSTALLATION PLUS LOW COST when you use LL-300 OPEN WIRE. Order through your Jobbers or write or free circular.

R. J. BUCHAN CO. BRICELYN 1, MINN.

Read
RADIO & TELEVISION NEWS
Every Month



HIGH SPEED WITHOUT NERVOUS TENSION

REVEALING BOOK shows how "crack" operators develop high speed and proficiency. Learn code for Amateur or Commercial Radiotelegraph License, or improve your sending and receiving with the Candler System which develops radio-telegraph experts and code champions.

CANDLER SYSTEM CO.
Box 928, Dept. 2-H, Denver, Colo.

FREE BOOK

'know how' governing the proper operations and maintenance of these receivers, and also recognize the fact that labor time will be high on those brands not serviced daily by the technicians."

Mr. Creàto placed particular emphasis on customer relations. He stressed that good "customer relations" begin at the time a service call is received at the office and must be carried through by the actions and attitude of the technician who handles the call.

In concluding he said, "this business of television servicing will grow even bigger in the years to come. Those people who give good service and operate on a sound business basis will be a part of that growth. Those people who give poor service or operate inefficiently will fail. We must set high goals and we must meet them. We must price for profits. We must make fair and reasonable charges. We must not over-charge but we must never dabble in cut-rate service. Each of us must conduct our service business so people will say:

" 'That is a dependable service organization. Their service will cost some money but it is worth it.' " —30—

HAMBOREE

THE Egyptian Radio Club, Inc. of Granite City, Illinois, is sponsoring its annual "Hamboree" on the Fourth of July.

The picnic and auction will run from 9 a.m. to 9 p.m. with refreshments continuously available.

To locate the picnic grounds hams should follow signs to the club located near the Illinois approach to the "Chain of Rocks" bridge on Route 66 north of Granite City, Illinois.

Additional details on this event are available from the Club secretary W. F. Guenneurg, Box 1300, R.R. 1, 700 S. Chouteau Slough Road, Granite City, Illinois. The club station is W9AIU. —30—

HONORS FOR TWO

JACK PERLMUTH and Sam Bialek of Clarostat were honored by the company at a cocktail party and banquet held during the Radio Parts Show in Chicago.

Both men received 25-year pins, gold watches, and scrolls as tokens of appreciation for their services to the firm. —30—

PHOTO CREDITS

Page	Credit
31, 32, 33, 34, 125	Dage Electronics Corp.
35	P. J. Samerjan
43	Sound Workshop
44 (left), 48, 49, 50, 112	Radio Corporation of America
44 (center & right)	Raytheon Manufacturing Co.
55	Zenith Radio Corporation
61, 98	The Heath Company

THE *Original* WRENCH WITH THE SCREWDRIVER ACTION!

SPINTITE
REG. U. S. PAT. OFFICE

120 STYLES and SIZES
for

- ASSEMBLY WORK
- REPAIR WORK
- RADIO
- TELEVISION
- INDUSTRIAL
- AIRCRAFT

WALDEN WRENCHES WORCESTER

STEVENS WALDEN, Inc.
WORCESTER 4, MASS.

BUILD 15 RADIOS AT HOME

ONLY $19.95

With the New Improved 1953 Progressive Radio "EDU-KIT"

NOW INCLUDES

SIGNAL TRACER and CODE OSCILLATOR

- FREE TOOLS WITH KIT
- ABSOLUTELY NO KNOWLEDGE OF RADIO NECESSARY
- NO ADDITIONAL PARTS NEEDED
- EXCELLENT BACKGROUND FOR TELEVISION
- 10-DAY MONEY-BACK GUARANTEE

WHAT THE PROGRESSIVE RADIO "EDU-KIT" OFFERS YOU

The "Edu-Kit" offers you a Home Radio Technician Course at a rock-bottom price. You will learn how to identify Radio Symbols and Diagrams; how to build radios, using regular radio schematics; how to wire and solder in a professional manner. You will learn how to operate Receivers, Transmitters, and Audio Amplifiers. You will learn how to service and trouble-shoot radios. You will learn code. You will receive training for F.C.C. license. In brief, you will receive a basic education in Radio exactly like the kind you would expect to receive in a Radio Course costing several hundred dollars.

THE KIT FOR EVERYONE

It is not necessary that you have even the slightest background in science or radio. The "Edu-Kit" is used by young and old; by radio schools and clubs; by the Veterans' Administration for Vocational Guidance and Training. No instructor is required. Instructions are complete, simple and clear. You cannot make a mistake.

PROGRESSIVE TEACHING METHOD

The "Edu-Kit" uses the principle of "Learn by Doing." Therefore you will build radios, perform jobs, and conduct experiments to illustrate the principles which you learn. You begin by learning the function and theory of each of the radio parts. Then you build a simple radio. Gradually, in a progressive manner, you will find yourself constructing more advanced multi-tube radio sets, and doing work like a professional Radio Technician. The "Edu-Kit" Instruction Books are exceedingly clear in its explanations, photographs and diagrams.

The Progressive Radio "EDU-KIT" Is Complete

You will receive every part necessary to build fifteen different radio sets. Our kits contain tubes, tube sockets, chassis, variable condensers, electrolytic condensers, mica condensers, paper condensers, resistors, line cords, selenium rectifiers, tie strips, coils, hardware, tubing, hook-up wire, solder, etc. Tools are included, as well as an Electrical and Radio Tester. Complete, easy-to-follow instructions are provided. In addition, the "Edu-Kit" now contains lessons for servicing with the Progressive Signal Tracer, F.C.C. instructions, quizzes. The "Edu-Kit" is a complete radio course, down to the smallest detail.

TROUBLE-SHOOTING LESSONS

Trouble-shooting and servicing are included. You will be taught to recognize and repair troubles. You will build and learn to operate a professional Signal Tracer. You receive an Electrical and Radio Tester, and learn to use it for radio repairs. While you are learning in this practical way, you will be able to do many a repair job for your neighbors and friends, and charge fees which will far exceed the cost of the "Edu-Kit." Our Consultation Service will help you with any technical problems which you may have.

FREE EXTRAS IN 1953

• Electrical and Radio Tester • Electric Soldering Iron • Book on Television • Radio Trouble-Shooting Guide • Membership in Radio-Television Club • Consultation Service • Quizzes • Training for F.C.C. License

Send me the "Edu-Kit" with Money-back Guarantee—include All FREE extras.

☐ Check or M.O. enclosed—postage prepaid

☐ C.O.D. (U. S. Only)—I will pay postage

☐ Send further information

Outside U.S.A.—cash orders only; send intern't'l M.O. or check on U.S. bank. Postage Prepaid. "Edu-Kit" for 210-250 V. AC/DC $22.45.

NAME____________________

ADDRESS____________________

____

PROGRESSIVE ELECTRONICS CO.
497 Union Ave., Dept. RN-20, Brooklyn 11, N.Y.

INDEX OF *Advertisers*

JULY 1953

[While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.]

ADVERTISER — PAGE

Airex Radio Corp. 90
Allied Radio Corp. 9
Almo Radio Company 56
American Microphone Co. 103
American Phenolic Corporation 26
American Television & Radio Co. 101
Amperite Company 96
Amplifier Corp. of America 98
Arkay Radio Kits 90
Arrow Electronics 110
Arrow Sales 76
Asco Sound Corporation 117
Ashe Radio Company, Walter 28
Atlas Sound Corp. 110
Audak Company, Inc. 104
Audel, Publishers 104

Bell Telephone Laboratories 6
Boulevard Electronics, Inc. 103
Brook Electronics, Inc. 116
Buchan Company, R. J. 135

C & H Sales Co. 92
Candler System Co. 135
Capitol Commodities Co., Inc. 112
Capitol Radio Engineering Institute 93
C B S Hytron 81
Centralab 19
Century Electronics Co. 137
Channel Master Corporation .... 20 & 21
Cleveland Institute of Radio Electronics 25
Collins Audio Products Co., Inc. 13
Columbia Electronic Sales 132
Commissioned Electronics Co. 137
Communication Equipment Co. 132
Concord Radio 22, 76
Cook Labs, Inc. 123
Coyne Electrical School 129

DeCray & Associates, Frank W. 100
DeForest's Training, Inc. 5
Du Kane Corporation 131

Editors & Engineers Limited 129
Electronic Instrument Co., Inc. 30, 76
Electronic Measurements Corp. 109
Electronic Specialty Supply Co. 121
Electro Voice 8
Erie Resistor Corporation 114

Fairchild Recording Equipment 131
Fair Radio Sales 120
Federal Telephone & Radio Corporation .... 3rd cover
Fisher Radio 89
Franklin Technical Institute 123

G & H Wood Products 109
G. L. Electronics 94
General Electric Company 27
Goodheart, R. E. 117
Greenlee Tool Co. 82
Greenwich Sales Company 133

Hallicrafters 7
Harvey Radio Company 122
Heath Company 71/74, 95
Henshaw Radio Supply 123
Hughes Research & Development Laboratories 70, 96

Illinois Research Laboratories 68
Indiana Technical College 129
Instructograph Company 110
International Resistance Co. 83

J F D Mfg. Co. 119
J S H Sales Co. 119
Jensen Industries, Inc. 82
Jones & Laughlin Steel Corporation 18

K. W. Sales Company 113

Lako Company 121
Lampkin Laboratories 129
LaPointe Electronics, Inc. 14
Leeds Radio Co. 124
Leotone Radio Corp. 114

ADVERTISER — PAGE

McGee Radio Company 78/79
McGraw Hill Book Co., Inc. 108
Mallory & Company, P. R. .... 17, 4th cover
Mattison Television & Radio Corp. 86
Michel Mfg. Co. 133
Miles Reproducer Co., Inc. 127
Milwaukee School of Engineering 84
Moss Electronic Distributing Co., Inc. 85

National Company 121
National Electronics of Cleveland 96
National Radio Institute 3
National Schools 23
Newark Electric Company 82
Newark Surplus Materials Co. 126
Newcomb Audio Products Co. 24

Offenbach & Reimus 125
Olson Radio Warehouse 99
Onan & Sons, D. W. 102

Peak Electronics Co. 126
Perma-Power Company 102
Phillips Tube Company, Incorporated 90
Photocon Sales 120
Pickering & Company 29
Platt Electronics Corp. 130
Premax Products 120
Premier T.V. Radio Supply 97
Progressive Electronics 136

Quietrole Company 114

RCA Institutes, Inc. 91, 133
R. W. Electronics 123
Radiart Corporation 12
Radio City Products, Inc. 134
Radio Corporation of America .... 2nd cover
Radio Craftsmen, Inc. 16
Radio Engineering Company 136
Radio-Television Training Association 15
Rad-Tel Tube Co. 137
Raytheon Mfg. Company 67
Regency 92
Relay Sales 106
Rider Publisher, Inc., John F. 100
Rinehart Books, Inc. 131

Sams & Company, Howard W. 75, 88
Sarkes Tarzian, Inc. 110
Schott Company, Walter L. 11
Shure Brothers 128
South River Metal Products Co., Inc. 68
Sprayberry Academy of Radio 69
Stan Burn Radio & Electronics 125
Stephan Sales Corp. 104
Steve-El Electronics Corp. 68
Stevens Walden, Inc. 135
Sun Parts Distributors, Ltd. 108
Sylvania Electric Products, Inc. 87

TAB 138
Television Communications Institute 102
Terado Company 125
Transvision, Inc. 118, 119
Trio Manufacturing Co. 77
Tri-State College 119

United States Wire & Cable Corporation 111
University Loudspeakers, Inc. 124

V-M Corporation 115
Valparaiso Technical Institute 127

Waldom Electronics, Inc. 100
Western Electronics Co. 127
Western Television Institute 90
Westinghouse Electric Corporation 10
Wholesale Radio Parts Co., Inc. 133
Windsor Electronic Tube Co. 125
World Radio Laboratories 127

NEW IDEAS WANTED. .NEW ELECTRONIC ACCESSORY ITEMS
TO MANUFACTURE AND MARKET

Sales and Service Organization Available . . . What Have You to Offer in Facsimile
• Industrial Television • Telephone • Radio

Note . . . We Have a Special, Immediate Need of Facsimile Equipment for Intra-office and Plant Use.

We Need . . . Selective Radio Signal Transmitter and Selective Radio Signal Receivers to Locate Doctors in Hospitals.

Receiver Weight Should Be 5-10 Ounces

RADIO ENGINEERING COMPANY
Inquirer Building, Philadelphia 30, Pennsylvania